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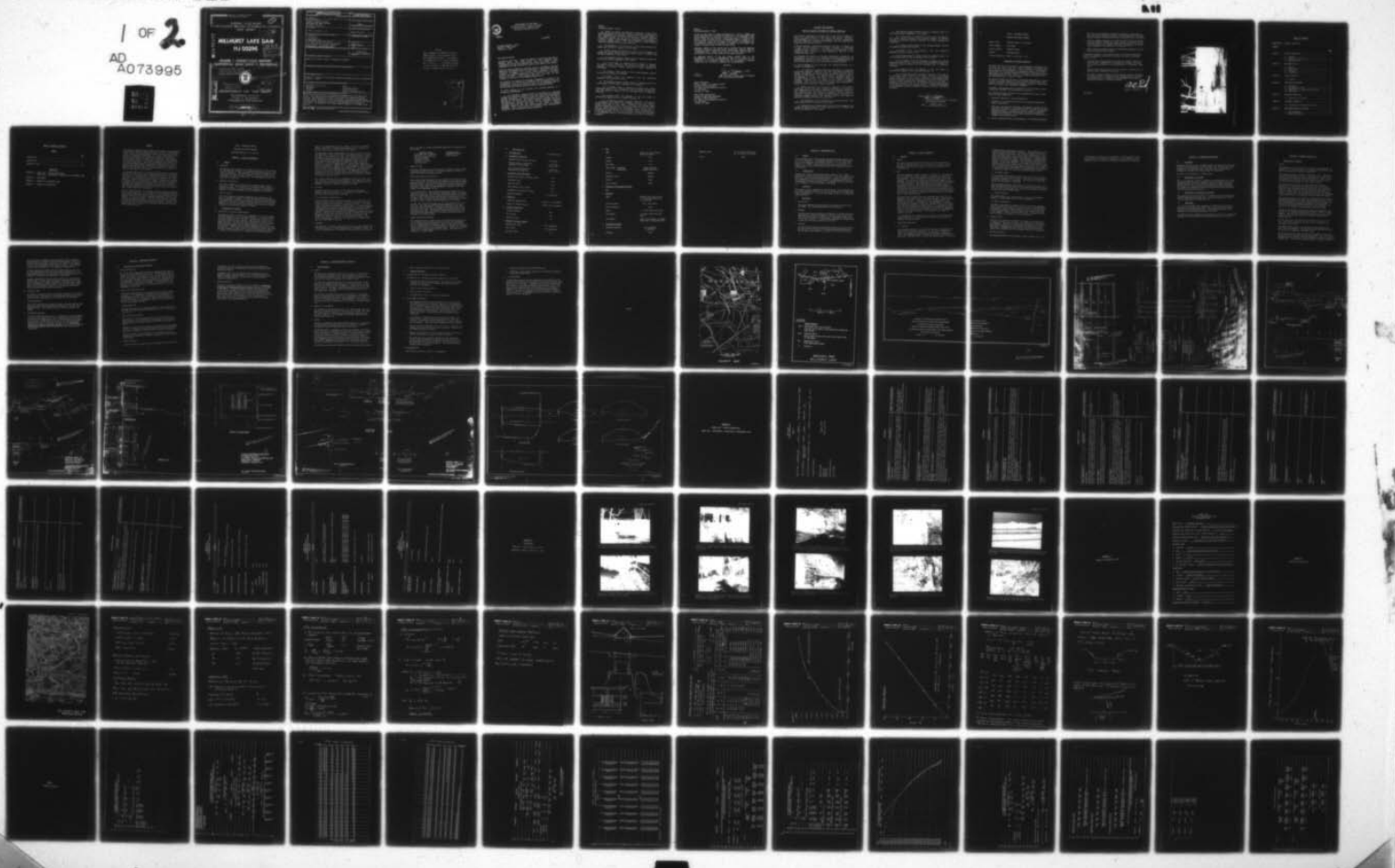

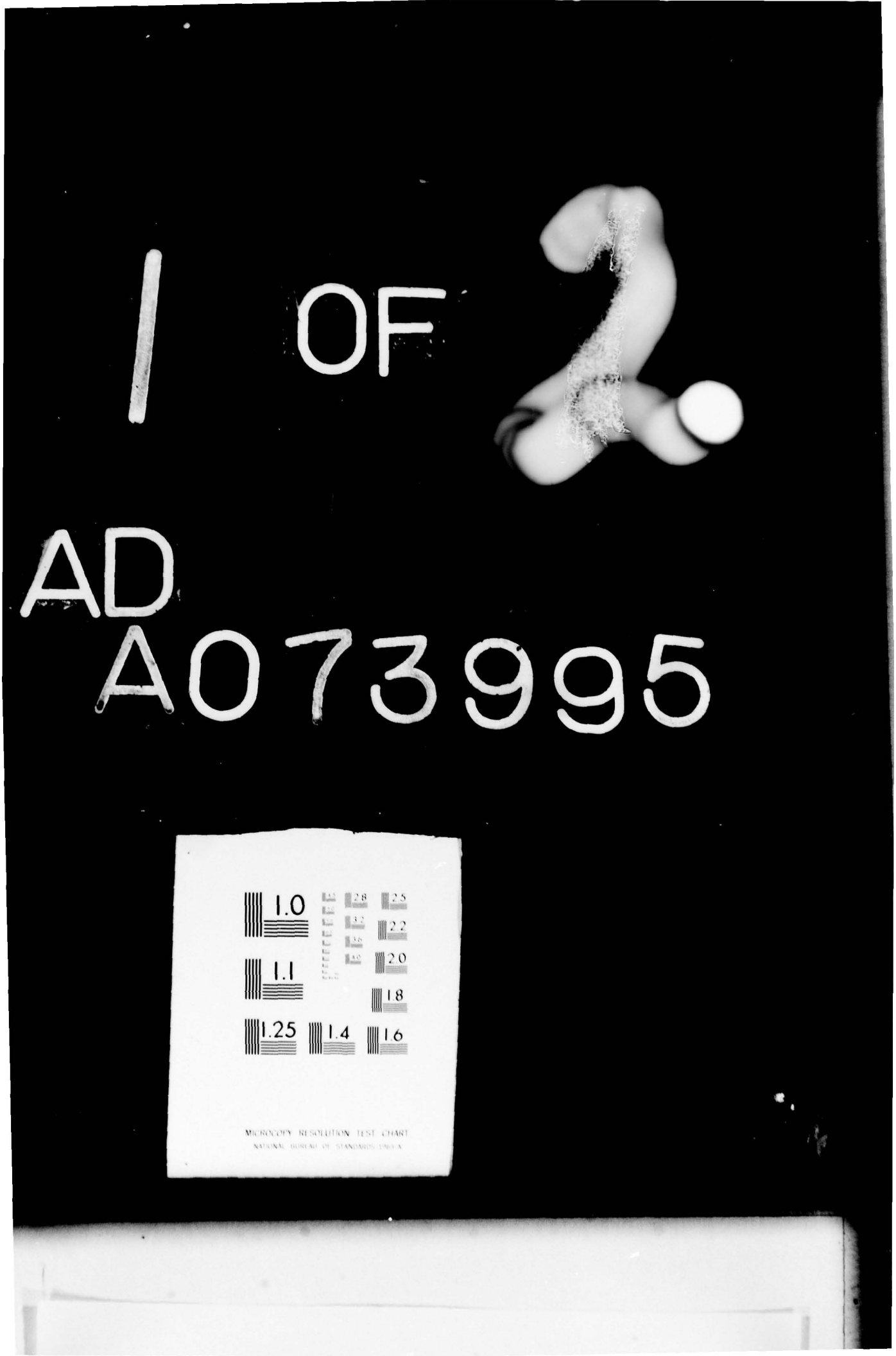
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RARITAN RIVER BASIN
MANALAPAN BROOK, MONMOUTH COUNTY
NEW JERSEY

LEVEL II

MILLHURST LAKE DAM
NJ 00296

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Millhurst Lake Dam, NJ-00296.
Raritan River Basin, Manalapan Brook,
Monmouth County, New Jersey.
Phase I Inspection Report.

Final rept.,

95 p.

Anthony G. /Posch

DACW61-79-C-0011

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

August 1979

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Millhurst Lake Dam, N.J.	Dams
Embankments	Structural Analysis
Spillways	Visual Inspection
Seepage	National Dam Inspection Act

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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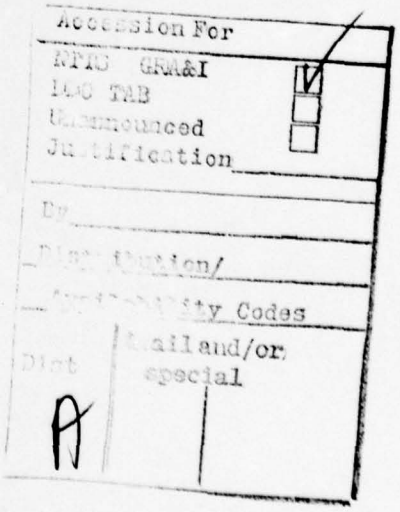

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE - 2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-D

12 SEP 1979

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Millhurst Lake Dam in Monmouth County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Millhurst Lake Dam, a high hazard potential structure, is judged to be in poor overall condition. The dam's spillway is considered inadequate since 23 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood).

The decision to consider the spillway "inadequate" is based on the determination that dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to determine the dam's embankment and foundation condition and structural stability. This should include test borings to determine material properties relative to stability and seepage and installation of piezometers to facilitate seepage studies. Any remedial measures found necessary should be initiated within calendar year 1980.

c. The ownership of the dam should be established within three months from the date of approval of this report.

d. Provide concrete underpinning at the toe of the wingwalls, and replace the missing masonry wall with concrete within six months from the date of approval of this report.

e. The following remedial actions should be completed within one year from the date of approval of this report:

(1) A safe means of lowering the lake should be provided. This would involve restoring the existing penstock to operable condition of providing suitable apparatus for safely removing the stop-planks.

(2) Restore eroded masonry at the spillway/wingwall junction and repoint all masonry as necessary.

(3) Remove trees and vegetation from the downstream embankment face and seed with grass.

f. The following remedial actions should be completed within one to three years from the date of approval of this report;

(1) A program should be developed to monitor the seepage through and under the dam. Depending on the information provided, the need for corrective measures can be considered and, if necessary, undertaken.

(2) Existing plans and drawings of the dam should be annotated and updated to form a coherent as-built set.

(3) A formalized program of annual inspections of the dam by an experienced party should be initiated, utilizing the standard visual check list in this report. Headwater and tailwater gages should be installed in the dam, and read out during severe rain storms and at routine operating and maintenance visits to the dam. A permanent log should be kept of all maintenance and operating events of the dam, the lake and the outlet passages. Movement and settlement of the embankment should be monitored regularly by means of surveying monuments.

NAPEN-D
Honorable Brendan T. Byrne

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James J. Howard of the Third District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

1 Incl
As stated

Copies furnished:
Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

MILLHURST DAM (NJ00296)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 30 April and 1 June 1979 by Frederic R. Harris, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Millhurst Lake Dam, a high hazard potential structure, is judged to be in poor overall condition. The dam's spillway is considered inadequate since 23 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood).

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a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to determine the dam's embankment and foundation condition and structural stability. This should include test borings to determine material properties relative to stability and seepage and installation of piezometers to facilitate seepage studies. Any remedial measures found necessary should be initiated within calendar year 1980.

c. The ownership of the dam should be established within three months from the date of approval of this report.

d. Provide concrete underpinning at the toe of the wingwalls, and replace the missing masonry wall with concrete within six months from the date of approval of this report.

e. The following remedial actions should be completed within one year from the date of approval of this report:

(1) A safe means of lowering the lake should be provided. This would involve restoring the existing penstock to operable condition of providing suitable apparatus for safely removing the stop-planks.

(2) Restore eroded masonry at the spillway/wingwall junction and repoint all masonry as necessary.

(3) Remove trees and vegetation from the downstream embankment face and seed with grass.

f. The following remedial actions should be completed within one to three years from the date of approval of this report;

(1) A program should be developed to monitor the seepage through and under the dam. Depending on the information provided, the need for corrective measures can be considered and, if necessary, undertaken.

(2) Existing plans and drawings of the dam should be annotated and updated to form a coherent as-built set.

(3) A formalized program of annual inspections of the dam by an experienced party should be initiated, utilizing the standard visual check list in this report. Headwater and tailwater gages should be installed in the dam, and read out during severe rain storms and at routine operating and maintenance visits to the dam. A permanent log should be kept of all maintenance and operating events of the dam, the lake and the outlet passages. Movement and settlement of the embankment should be monitored regularly by means of surveying monuments.

APPROVED: _____
JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

DATE: 11 September 1979

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam: Millhurst Lake, I.D. NJ00296

State Located: New Jersey

County Located: Monmouth County

Stream: Manalapan Brook

Date of Inspection: April 30 and June 1, 1979

Assessment of General Condition

Millhurst Lake Dam is an earth-fill road embankment approximately 270 feet long and 24 feet high, with a concrete spillway. Millhurst Lake Dam is in poor overall condition. There is evidence of slow progressive movement of the embankment and widespread erosion of fill has taken place. The spillway wingwalls show signs of settlement and have been undermined at the toe. There is no operable low-level outlet. The hazard potential is rated as "high."

The safety of Millhurst Lake Dam is considered questionable in view of its lack of spillway capacity to pass one half the PMF without overtopping of the dam. The spillway is capable of passing a flood equal to 11% of the PMF, and is assessed "inadequate."

At present, the engineering data available is not sufficient to make a definitive statement on the stability of the dam.

The following actions, therefore, are recommended along with a timetable for their completion.

1. Establish ownership of the dam immediately.

2. Establish a flood warning system for the downstream communities within three months.

3. Carry out a more precise hydrologic and hydraulic analysis of the dam within six months, to determine the need and type of mitigating measures necessary. If required, conduct a study of the means of increasing spillway discharge capacity and develop alternative schemes for construction. This should include the installation of headwater and tailwater gages.

4. Install observation wells or piezometers in the downstream embank-

ment, and log the borings to determine engineering properties of the dam fill and foundation material. This program and a stability analysis based on the findings should be completed within six months.

5. Carry out remedial measures to the dam structure within six months, including repair of eroded and cracked masonry; restoration of the low-level outlet to an operable condition; underpinning of wingwall toes; replacement of eroded fill to a slope of 2 on 1.

6. Remove trees and vegetation from the downstream embankment face and seed with grass within 12 months.

Furthermore, while of a less urgent nature, the following additional action is recommended and should be carried out within a reasonable period of time.

1. A program should be developed to monitor the seepage through and under the dam. Depending on the information provided, the need for corrective measures can be considered and, if necessary, undertaken.

2. Existing plans and drawings of the dam should be annotated and updated to form a coherent as-built set.

3. A program of annual inspection and maintenance should be initiated. This should include lowering the lake, and updating the operation and maintenance log. Movement of the embankment should also be monitored by means of surveying monuments.

A. G. Posch

Anthony G. Posch, P.E.

AGP/REJ/ak

Millhurst Lake Dam
Overall view of spillway structure from downstream.

January 30, 1979

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PLATES

APPENDICES

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

MILLHURST LAKE DAM, I.D. NJ00296

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The National Dam Inspection Act (Public Law 92-367, 1972) provides for the National Inventory and Inspection Program by the U.S. Army Corps of Engineers. This inspection was made in accordance with this authority under Contract C-FPM No. 35 with the State of New Jersey who, in turn is contracted to the Philadelphia District of the Corps of Engineers.

b. Purpose of Inspection

The visual inspection of Millhurst Lake Dam was made on April 30 and June 1, 1979. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

The report summarizes available pertinent data relating to the project; presents a summary of visual observations made during the field inspection; presents an evaluation of hydrologic and hydraulic conditions at the site; presents an evaluation as to the structural adequacy of the various project features; and assesses the general condition of the dam with respect to safety.

1.2 Description of Project

a. Description of Dam and Appurtenances

Millhurst Lake Dam is an earth-fill embankment 23.4 feet in height and approximately 270 feet in length, having a 27 foot wide spillway at the middle point of the dam. The spillway consists of two concrete sections of ogee shape on either side of a double stop-plank structure. The dam forms part of Millhurst Road, a two-lane paved road which passes over a timber bridge at the spillway. The spillway wingwalls form the bridge abutments and are of masonry construction. The bridge deck has an intermediate support structure of braced timber circular piles, driven into the spillway channel. The apron of the spillway is of concrete construction and steps

down to the downstream end in two stages. There is a wide-gage debris interceptor of timber piles upstream of the spillway, to prevent large objects from blocking the channel.

The embankment extends approximately 130 feet to the left of the spillway and 110 feet to the right. The upstream face is retained for most of its length by a 10 foot high timber bulkhead. Steel interlocking sheet-piles have been driven to reinforce the spillway inlet channel and the adjacent embankment face. The downstream face of the embankment is sloped at steeper than 2H:1V, except for a length of approximately 40 feet on the right side which is retained by a masonry wall. Some makeshift timber sheeting has been installed to support the downstream edge of the road where local erosion of the embankment has taken place. The downstream face is covered with trees and brush. The embankment carries overhead power cables on pylons and has traffic barriers on both sides of the road. No evidence was found to indicate the presence of a clay or concrete core.

The old mill works are still in existence, but are not used. The mill consists of a four storey building on the right side of the dam with associated machinery and penstock. The penstock, not now operable, is the only low-level outlet to the dam.

b. Location

Millhurst Lake Dam is located in the Township of Manalapan, Monmouth County, New Jersey. It is accessible by means of Millhurst Road which passes across the dam.

c. Size and Hazard Classification

Millhurst Lake Dam has a structural height of 23.4 feet and a reservoir storage of 360 acre-feet. Since its storage is less than 1,000 acre-feet and its height is less than 40 feet, it is classified in the dam size category as being "small." A hazard potential classification of "high" has been assigned to the dam on the basis that failure would result in excessive damage to the road and overhead cables across the dam and to downstream property, including Route 33. Because the road across the dam is heavily traveled, and because Millhurst Lake is used for recreational purposes, the possibility exists of the loss of more than a few lives in the event of dam failure. There are few inhabitable buildings within one mile downstream of the dam.

d. Ownership

The ownership of Millhurst Lake Dam has not been firmly established. The bridge and road is owned and maintained by Monmouth County. Up to 1951, ownership was in the hands of the proprietors of Millhurst

Mills, but they no longer acknowledge ownership or responsibility for the dam.

Monmouth County	Millhurst Mills
Attention: Mr. W. Cokelet	Freehold, NJ 07728
Assistant County Engineer	(201) 462-2000
Board of Freehold	
1 Lafayette Place	
Freehold, NJ 07728	
(201) 431-7765	

e. Purpose of Dam

Millhurst Lake Dam was originally built to provide a head of water for powering Millhurst Mill. Its present purpose is solely to retain the lake for recreational use.

f. Design and Construction History

Some drawings and photographs of the construction history exist on file at the NJDEP. The original dam appears to have been an earth embankment with a spillway consisting of the present masonry wing-walls and timber flood gates. The upstream face has always been retained by some form of timber bulkhead. Additional fill was placed on the embankment in 1915.

In the early 1940's, the spillway structure was found to be in a dangerous condition. The lake was accordingly lowered, the timber gates were demolished and the County then provided for the installation of steel interlocking sheet-piles at the spillway inlet. It appears that the lake level was allowed to fluctuate for approximately 10 years, without further construction on the dam.

In 1953, the concrete spillway and the stop-plank gate were constructed. The road was widened and straightened at this time, and a new bridge was built. The debris interceptor was also installed at this time. No major modifications are known to have been made since 1953. The Monmouth County Engineers Office has coordinated and approved most of the design and construction of the dam in the last 40 years.

g. Normal Operating Procedures

The discharge from the lake is over the unregulated spillway and it is allowed to naturally balance with inflow from Manalapan Brook. Stop-planks are normally in place at the same elevation as the spillway crest, and no easy method of removal of the planks exists, with the lake at its present level. The one 54" low-level outlet has not been operable for many years. The lake is not lowered on a regular basis.

1.3 Pertinent Data

a. Drainage Area	6.9 square miles
b. Discharge at Dam Site	
Maximum known flood at dam site:	No records.
Ungated spillway capacity at elevation of top of dam:	1,350 cfs (elev. 120.4')
Total spillway capacity at maximum pool elevation:	2,096 cfs (elev. 125.1')
c. Elevation (feet above MSL)	
Maximum pool design surcharge (SDF):	125.1
Recreation pool:	114.0
Spillway crest:	113.8
Lake overflow (top of dam):	120.4
Streambed at centerline of dam:	97
Maximum tailwater:	110 (estimate)
d. Reservoir	
Length of maximum pool:	6,000 ± feet (estimate)
Length of recreation pool:	3,000 ± feet (estimate)
e. Storage (acre-feet)	
Design Surcharge:	843
Top of dam:	360
Spillway crest:	58
f. Reservoir Surface (acres)	
Maximum pool (SDF):	120 (estimated)
Top of dam:	74 (estimated)
Spillway crest:	25

g. Dam

Type:	Earth fill with concrete/ masonry spillway.
Length:	270'
Height:	23.4'
Top width:	30'
Side Slopes - Upstream:	Timber bulkhead
- Downstream:	Steeper than 2H:1V
Zoning:	Unknown
Impervious core:	Unknown
Cutoff:	None
Grout curtain:	None

h. Diversion and Regulating Tunnel

N/A

i. Spillway

Type:	Ungated ogee overflow with 7.7' wide stop plank gate in the center.
Length of weir:	23.5' (net width)
Crest elevation:	113.8'
Gates:	7.7' wide timber stop plank
U/S Channel:	27' wide, lined with steel sheet.
D/S Channel:	After the spillway, a stepped apron down to Manalapan Brook.

j. Regulating Outlets

Low-level outlets:	54" ø Penstock (inoperable)
Controls:	None

Emergency gate:	7.7' wide stop plank structure in center of spillway.
Outlet:	None

SECTION 2: ENGINEERING DATA

2.1 Design

Brief computations for the original spillway discharge capacity are on file at the NJDEP. A dam permit application of 1941 gives some data on dam dimensions and hydraulic capacity. No data from soil borings, soil tests or other geotechnical data are available. No computations or dam cross-sections suitable for assessing stability are available.

2.2 Construction

Construction history has been provided in Section 1.2.f. Some drawings are on file, which contain details of the modifications made since 1941 and have been reproduced herein. Further information on the construction of the dam is available in photographs and in the correspondence between the owners of the dam and the County Engineer. This information is on microfiches at the NJDEP.

2.3 Operation

No records of recent operation of the dam exist. Some information on lake levels between 1940 and 1953 is also contained in the above mentioned correspondence. It is not known when the mill or the penstock ceased operation.

2.4 Evaluation

a. Availability

The stated drawings and microfiches were freely available from the NJDEP. No other Engineering Data is available.

b. Adequacy

The Engineering data available was adequate to perform hydrologic computations, although the depth of the lake is not known. The data was insufficient to perform even an approximate computation of the dam's stability. A preliminary assessment of the dam could be made with the data obtained in the field.

c. Validity

The 1953 drawings contain many details which are no longer valid, but the plan and elevation of the dam are approximately correct. The spillway crest elevation is incorrect in the 1941 drawings.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

The visual inspection made of Millhurst Lake Dam revealed that the dam and spillway were in poor condition, and that a regular program of inspection and repair is required to maintain its serviceability.

b. Dam

The earth embankment exhibits signs of instability. The upstream face, retained by a timber bulkhead, is failing by gradual outward movement. This is evidenced by surface cracks in the road parallel to the center line and by vertical misalignment of the bulkhead. Rotting of the timber does not appear to have progressed to a dangerous level. The downstream face is steeper than 2H:1V, and surface runoff from the road has caused extensive erosion. Intermittent patching and reinforcement of the road shoulder with blacktop has been carried out by the County, but this method and the practice of shoring up the road with planking has not prevented erosion from continuing. Material loss from behind the left abutment is particularly severe.

The only notable seepage from the downstream face was from the embankment toe within 5 feet of the left abutment. Tree and brush growth on this face is heavy and the root system appears to be stabilizing the fill. Settlement of the embankment is evident. The horizontal alignment of the road indicates that it now slopes away from the bridge deck on both sides: it is assumed that when the road was realigned, its elevation was the same as the bridge deck. It was not possible to determine visually if the embankment has been built with a corewall. No evidence of burrowing by animals was found.

The dam appears to be founded on and constructed of Red Bank and Tinton Falls sands. (The high silt content of these sands has impeded internal drainage.)

c. Appurtenant Structures

1. Spillway

The spillway consists of two concrete ogee weirs separated by two 4-feet wide stop-plank structures. At the time of inspection, water flow was smooth, indicating that horizontal alignment is good. Any leakage through or around the spillway was not detectable due to the water flow. Erosion has taken place at the junction

between spillway and masonry wingwalls. Steel sheet-piles in the spillway inlet channel have good vertical alignment and show no sign of extensive corrosion. The concrete spillway apron is in good condition except at the junction with the wingwalls, where erosion of masonry and concrete has taken place. Undermining at the toe of the apron is slight. Both wingwalls have been undermined at the toe, and subsequent loss of masonry blocks has occurred. In the right wingwall, a settlement crack extends at 45° from the apron to the top of the wall, and is as much as 2 inches wide. Both wingwalls have been recently repointed. The growth of trees near and on the wingwalls is endangering their stability, in particular where the roots are loosening masonry joints.

2. Low-Level Outlet

A 54" diameter steel penstock feeding the old mill was visible at the base of the wall near the mill. The inlet to the penstock is silted up, rendering it inoperable. The location of the outlet beyond the mill works is not known.

The stop-plank structure also serves as a low-level outlet. Removal of planks would be difficult and dangerous with the existing flow of water over the spillway. The structure appears sound and no leaks were noted between planks.

3. Bridge and Piers

The timber bridge is in good condition. The one intermediate support of round timber piles is also satisfactory.

4. Debris Interceptor.

The debris interceptor of timber piles is functioning adequately. Some of the bracing between piles has been lost. The interceptor is necessary to keep floating trees and other large debris from blocking the spillway. Since the debris are forced to the side of the channel, leaving the interceptor clear, it appears reasonable to ignore any impedance of flow caused by it.

d. Reservoir Area

The rim of the reservoir is moderately sloped, and covered with a heavy growth of trees and brush. No indication of instability was apparent. There are a few residential properties on the left bank and the buildings and store-yard of Millhurst Mill on the right bank. Sedimentation has occurred near the dam and weed growth on the sediment above the present waterline is widespread.

e. Downstream Channel

The downstream channel winds through a broad, wooded valley. The

stream banks are steep due to undermining. This has caused trees to fall across the stream and has led to local instability of the embankment near the dam, with subsequent undermining of wingwalls.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

Millhurst Lake Dam is used to impound water for recreation activities. The policy is to maintain a nearly constant lake level close to the elevation of the spillway crest. The lake level is maintained by unregulated discharge over the spillway and stop-planks.

The lake is not lowered on a regular basis.

4.2 Maintenance of the Dam

There is no program of regular inspection and maintenance of the dam and appurtenant structures. Monmouth County has made periodic unrecorded repairs to the dam when such action was needed to protect their road. No Authority has been identified as being responsible for operating or maintaining the dam itself and no recent records of these functions have been found.

4.3 Maintenance of Operating Facilities

The operating facilities consist of a defunct low-level penstock and manually operated stop-plank gate. No recent maintenance is known to have taken place of either facility.

4.4 Evaluation

It is highly desirable that ownership of Millhurst Lake Dam be established, as the essential first stage in initiating a program of regular inspection and maintenance. The present situation is not conducive to satisfactory operation of the dam.

The present and past operational procedures are poor, and a formalized program of regular inspection and maintenance should be initiated.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

The drainage area above Millhurst Lake Dam is approximately 6.9 square miles. A drainage map of the watershed of Millhurst Lake damsite is presented on plate 1, Appendix D.

The topography within the basin is generally flat. Elevations range from approximately 200 feet above MSL at the south end of the watershed to about 110 feet at the dam site. Land use patterns within the watershed are mostly rural, with only a few buildings scattered around the lake, near the road.

The evaluation of the hydraulic and hydrologic features of Millhurst Lake was based on criteria set forth in the Corps Guidelines and additional guidance provided by the Philadelphia District, Corps of Engineers. The SDF for the dam falls in a range of ½ PMF to PMF. In this case the low end of the range, ½ PMF, is chosen since the factors used to select size and hazard classification are on the low-side of their respective ranges.

The probable maximum flood (PMF) was calculated from the probable maximum precipatation using Hydrometeorological Report No. 33 with standard reduction factors. Due to the small drainage area, the SCS triangular hydrograph transformed to a curvilinear hydrograph was adopted for developing the unit hydrograph, with the aid of the HEC-1DB Flood Hydrograph Computer program.

Initial and infiltration loss rates, using SCS procedures, were applied to the Probable Maximum Precipitation to obtain rainfall excesses. The rainfall excesses were applied to the unit hydrograph to obtain the PMF and various ratios of PMF utilizing program HEC-1DB.

The SDF peak inflow calculated for Millhurst Lake Dam is 7801 cfs. This value is derived from the 1/2 PMF, and results in overtopping of the dam.

The stage-outflow relation for the spillway was prepared from field notes and sketches. The reservoir stage capacity was based on the U.S.G.S. quadrangle topographic maps.

The reservoir storage capacity curve can be computed directly by the conic method, utilizing the HEC-1DB program. The conic method assumes that the reservoir capacity resembles a series of vertically stacked cones. The reservoir surface areas at various elevations

were measured by planimeters from topographic maps. Reservoir storage capacity included surcharge levels exceeding the top of the dam, and the spillway rating curve was based on the assumption that the dam remains intact during routing. The spillway rating curve is presented in the hydrologic computations.

A breach analysis indicates that the hazard potential for loss of life downstream, due to dam failure from overtopping, is not significantly greater than that which exists without failure, and therefore, the spillway is assessed as "inadequate."

Drawdown calculations indicate that by removal of stop planks in the spillway, the lake could be lowered to elevation 106.8' MSL within a period of 15 hours, assuming a 2 cfs/square mile inflow. This is considered an adequate time frame from the safety standpoint, but as indicated in Section 3, it should be understood that stop plank removal would be difficult.

b. Experience Data

No records of reservoir stage or spillway discharge are maintained for this site. The erosion on the downstream face may have been caused by past overtopping, but this could not be confirmed.

c. Visual Observation

The valley below the dam is heavily wooded, with much debris, and there are no dwellings immediately downstream of the dam, along Manalapan Brook. The slopes around the lake are moderate and wooded.

d. Overtopping Potential

A storm of magnitude equivalent to the SDF would cause overtopping of the dam to a height of 4.7 feet. Computations indicate that the dam can pass approximately 11% of the PMF without overtopping the dam crest. Since one half the PMF is the minimum Spillway Design Flood (SDF) for this dam, according to the Recommended Guidelines for Safety Inspection of Dams by the Corps of Engineers, the spillway capacity of the Millhurst Lake Dam is assessed as "inadequate."

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The visual observations made during the inspection give rise to concern about the stability of the dam. The downstream face is sloped too steeply to be stable, in view of the runoff from the road. The process of settlement of the road and outward tilting of the upstream bulkhead indicate a progressive, slow failure of the embankment. The amount of seepage from the embankment toe does not present undue cause for alarm. The stability of the wingwalls is questionable, as evidenced by overall cracking and undermining at the toe.

b. Design and Construction Data

No design computations were uncovered during the report preparation phase. No embankment or foundation soil parameters are available for carrying out a conventional stability analysis on the embankment. No construction data or specifications relating to the degree of embankment compaction are available for use in the stability analysis.

c. Operating Records

No operating records are available relating to the stability of the dam. The dam has served satisfactorily since its rehabilitation in 1953.

d. Post-construction Changes

Installation of the steel sheet piling in the early 1940's in and adjacent to the spillway inlet is reported to have greatly reduced seepage and erosion behind the wingwalls and under the apron.

Stability of the spillway and apron was improved by the addition, in 1953, of concrete to form the ogee sections behind the sheetpiles and to channel the flow away from the masonry wingwalls.

Periodic shoring up and patching of the road shoulder by the County have contributed to temporary improvement to the stability of the road.

e. Static Stability

A static stability analysis was not performed for Millhurst Lake

Dam because the lack of data on which to base assumptions of material properties and embankment cross-sections might produce misleading results.

Settlement cracks in the wingwalls, the steepness of the embankment slopes, surface cracks in the road and tilting of the timber bulkhead would all indicate that a slow progressive failure is taking place.

f. Seismic Stability

The dam is located in Seismic Zone 1, as defined in Recommended Guidelines for Safety Inspection of Dams, prepared by the Corps of Engineers. In general, projects located in Seismic Zones 0, 1 and 2 may be assumed to present no hazard from earthquake, provided the static stability conditions are satisfactory and conventional safety margins exist. Since the last two conditions are not fulfilled, and since the dam fill is principally a silty sand, failure by liquefaction in the event of an earthquake should be considered possible.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety

The dam has been inspected visually and a review has been made of the available engineering data. This assessment is subject to the limitations inherent in the visual inspection procedures stipulated by the Corps of Engineers for a Phase I report.

The safety of Millhurst Lake Dam is in question because the dam does not have adequate spillway capacity to pass the PMF or even one-half of the PMF without overtopping. Overtopping of the dam carries with it the danger of possible progressive failure of the dam or spillway. The dam's present spillway capacity can pass only about 11% of the PMF.

No definitive statement pertaining to the safety of the embankment can be made without acquisition of embankment and foundation material engineering properties and determination of phreatic levels in the downstream part of the embankment. The possibility of failure may exist, particularly in the event of seismic excitation.

b. Adequacy of Information

The information uncovered was adequate to perform hydrologic computations, although the depth of the lake is not known. The data was insufficient to perform even an approximate computation of the dam's stability. An assessment of the dam could be made by visual observation only.

c. Urgency

Studies to augment the spillway discharge capacity or to determine the hydrologic and hydraulic ability of the dam to withstand overtopping should be undertaken within six months.

Observation wells or piezometers should be installed in the downstream embankment to determine the location of the phreatic surface. The borings should be logged according to the Unified Soil Classification system by qualified personnel, and samples taken to determine the values of pertinent soil parameters for stability. This information should be obtained within six months, and should be evaluated immediately upon acquisition to perform stability analyses in accordance with Chapter 4.4 of the Corps Guidelines.

The existing dam plans and drawings should be annotated and updated

to form a coherent as-built set in the near future.

7.2 Remedial Measures

a. Alternatives for Increasing Spillway Capacity

Alternatives for increasing spillway capacity are as follows:

1. Increase the dam and bridge height, thus permitting a higher discharge to pass over the spillway and reducing the possibility of overtopping.

2. Lower the weir crest elevation.

3. Widen the weir structure.

4. A combination of any of the above alternatives.

b. Other Remedial Measures

1. The embankment material that has been lost by erosion from the downstream face, particularly adjacent to the abutments of the bridge/spillway, should be replaced with quarry-process stone or gravel. Slopes should be reconstructed with keying and compaction of material to improve stability and to support the abutments and wingwalls. Slopes should not be steeper than 2H:1V. This work should be undertaken within six months.

2. A safe means of lowering the lake should be provided. This would involve restoring the existing penstock to operable condition or providing suitable apparatus for safely removing the stop-planks. This work should commence within 12 months.

3. Provide concrete underpinning at the toe of the wingwalls, and replace the missing masonry wall with concrete. This work to be commenced within six months.

4. Restore eroded masonry at the spillway/wingwall junction and repoint all masonry as necessary within 12 months.

5. All brush and trees should be removed from the downstream slope to avoid problems which may develop from their roots. The embankment should than be seeded to develop a growth of grass for surface erosion protection. This program should be started within 12 months.

c. Recommendations

The following additional action is recommended.

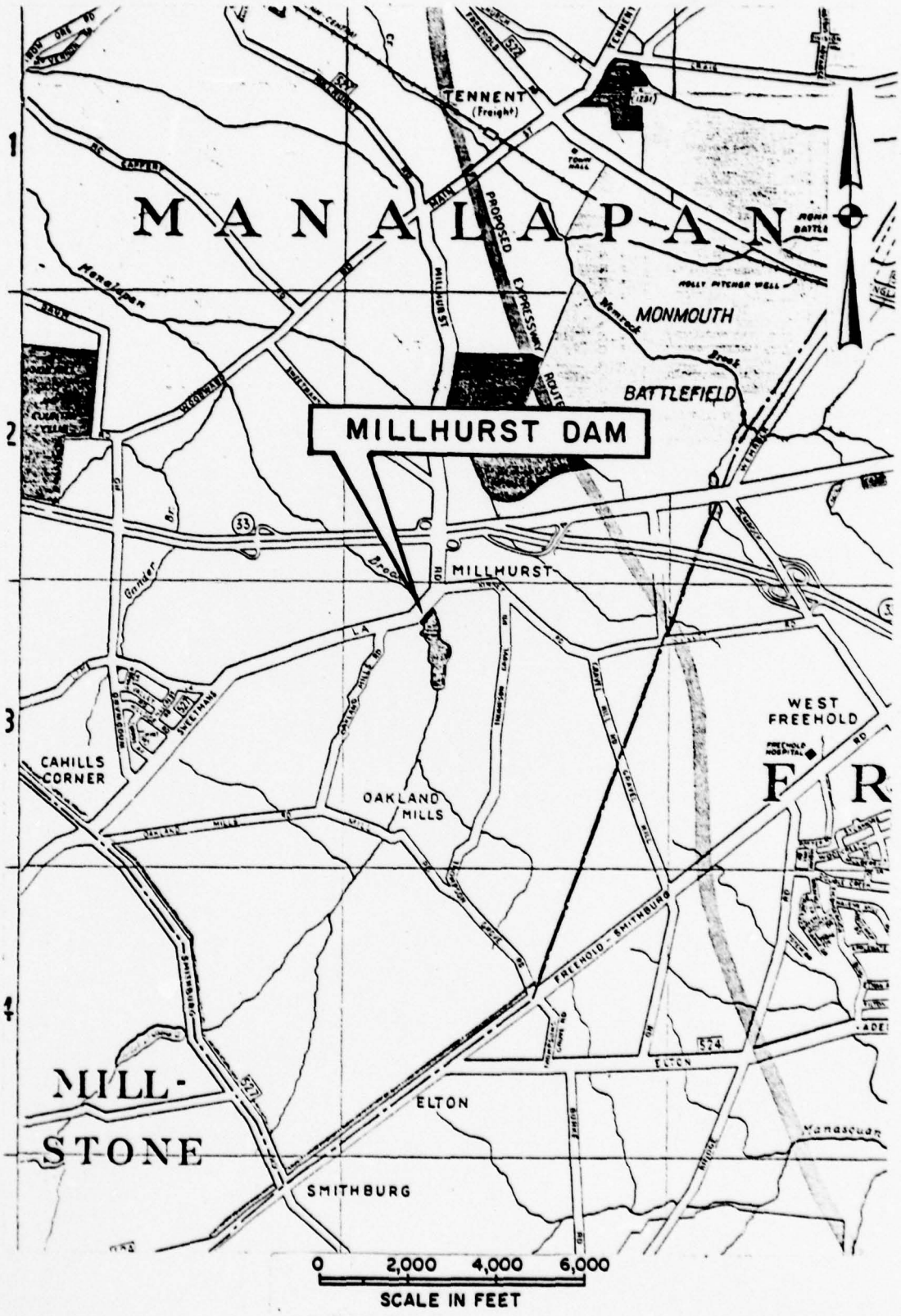
1. Establish ownership of the dam immediately.

2. Establish a flood warning system for the downstream communities within three months.

d. O & M Procedures

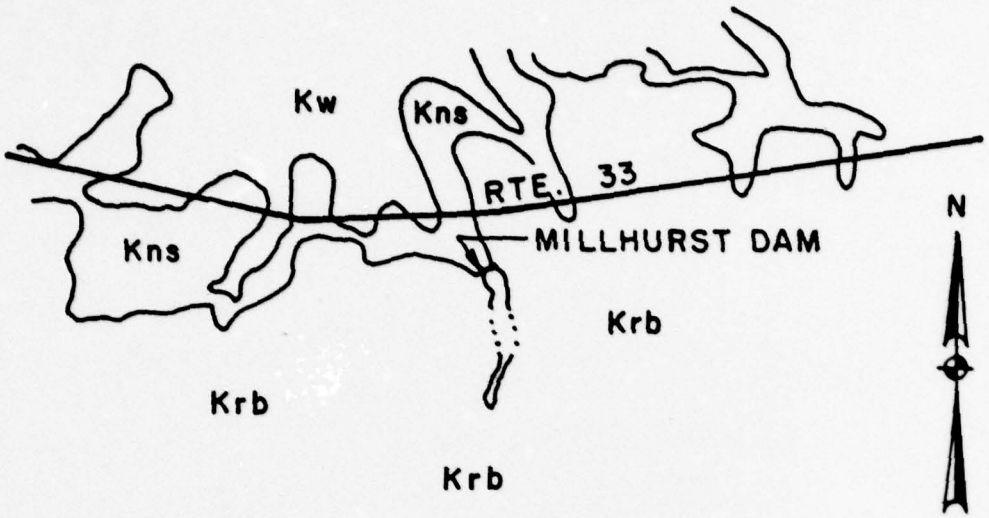
A formalized program of annual inspections of the dam by an experienced party should be initiated, utilizing the standard visual check list in this report. Headwater and tailwater gages should be installed in the dam, and read out during severe rain storms and at routine operating and maintenance visits to the dam. A permanent log should be kept of all maintenance and operating events of the dam, the lake and the outlet passages. Movement and settlement of the embankment should be monitored regularly by means of surveying monuments.

PLATES



VICINITY MAP

PLATE 1



1 0 1 2

Scale: 1" = 1 Mile

LEGEND

CRETACEOUS

Krb Red Bank and Tinton Sands
Coarse Rusty Sand, consolidated in places by Iron Oxide.

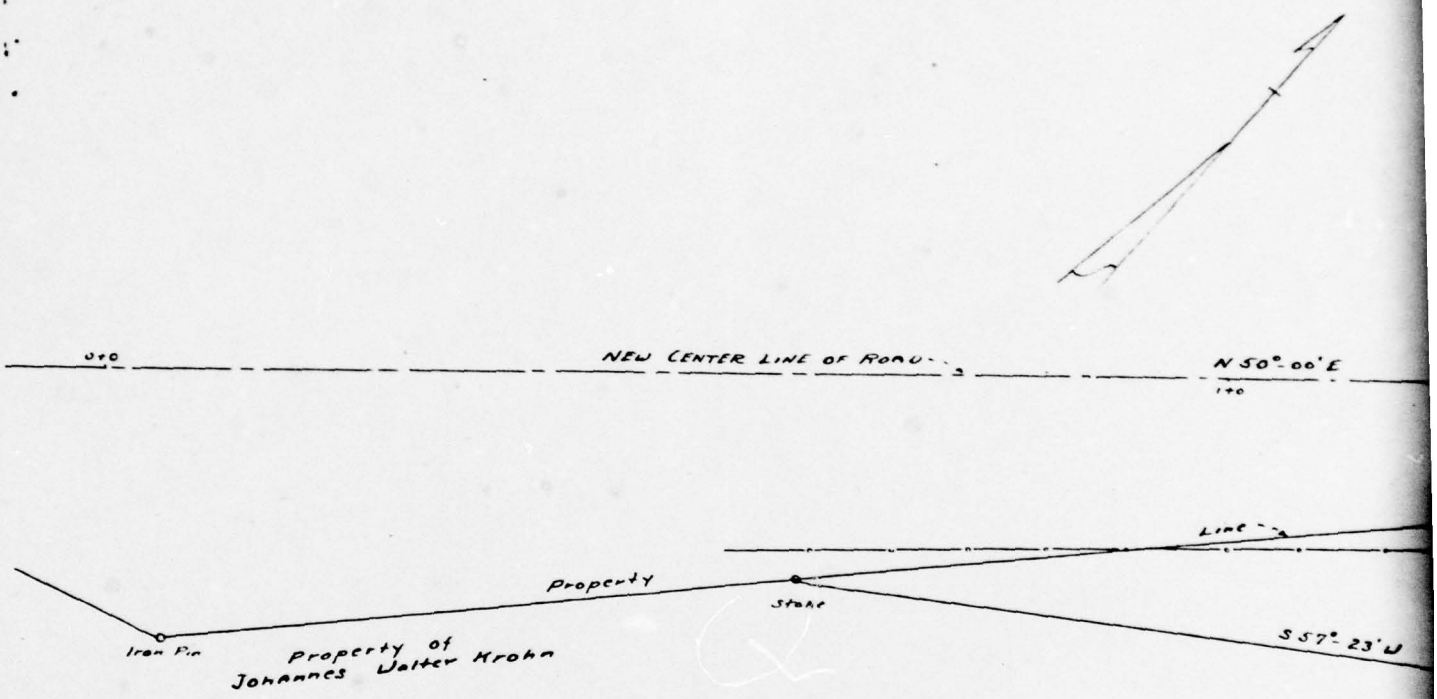
Kns Navsink Marl
Dark Green Glauconitic Marl with Shell Bed at the Base.

Kw Wenonath Sand
Fine Micaceous Sand.

— Contact

GEOLOGIC MAP
MILLHURST LAKE

PLATE 2



EASEMENT TO BE ACQUIRED BY MONMOUTH COUNTY

FROM JOHANNES WALTER KROHN FOR THE IMPROVEMENT

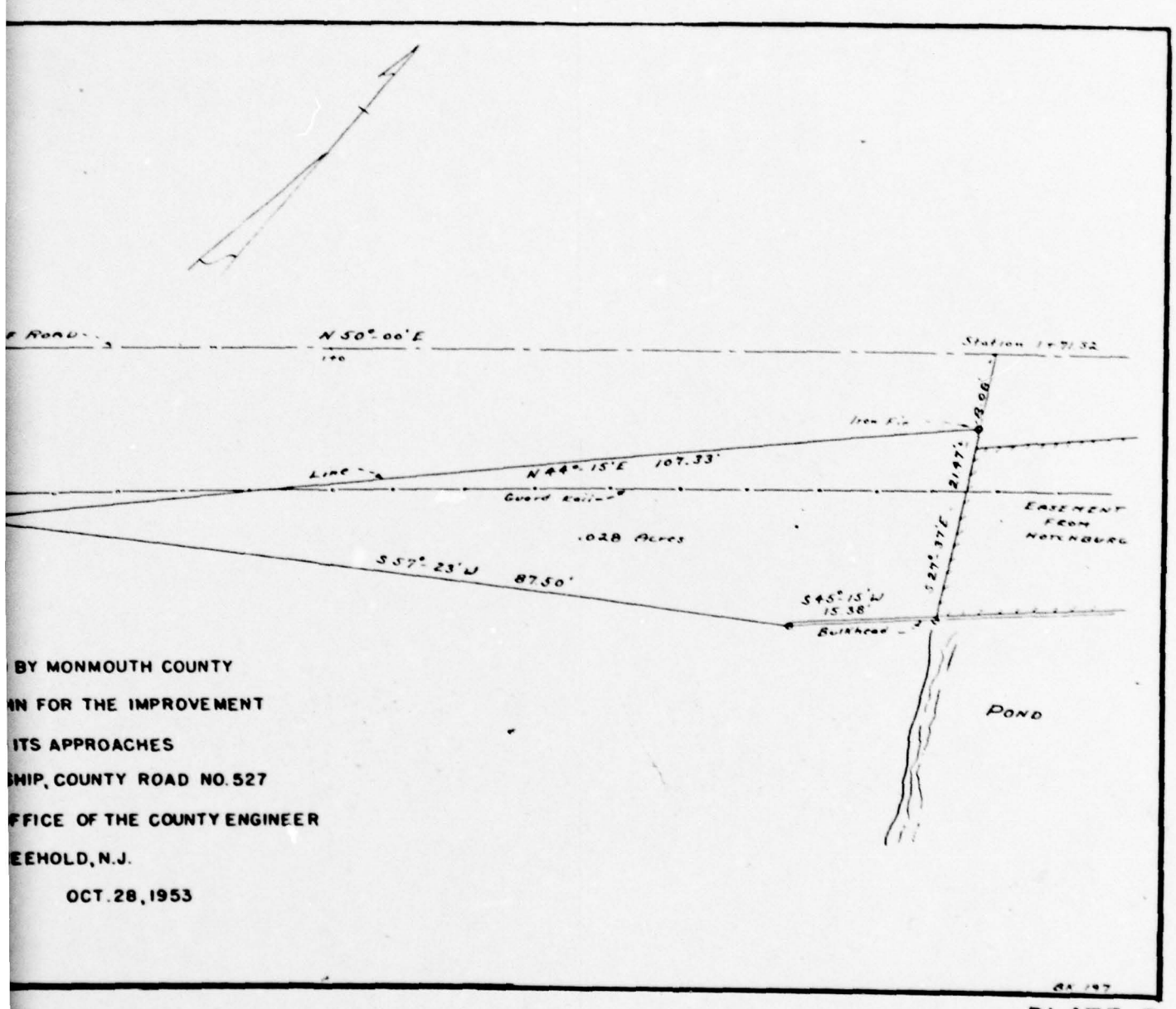
OF BRIDGE MN-10 AND ITS APPROACHES

LOCATED IN MANALAPAN TOWNSHIP, COUNTY ROAD NO. 527

AS SHOWN ON PLANS FILED IN THE OFFICE OF THE COUNTY ENGINEER

COURT HOUSE, FREEHOLD, N.J.

SCALE 1" = 10' OCT. 28, 1953



BY MONMOUTH COUNTY

IN FOR THE IMPROVEMENT

ITS APPROACHES

SHIP, COUNTY ROAD NO. 527

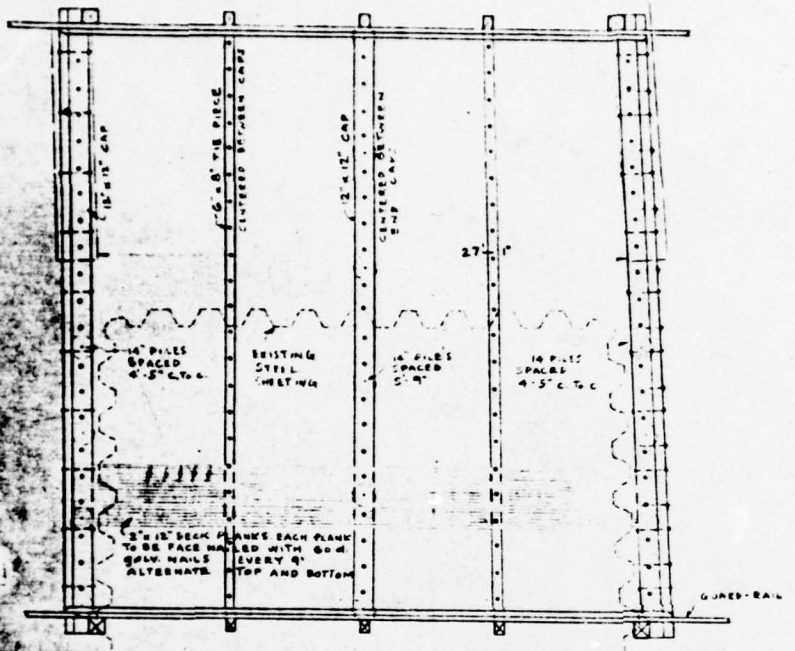
FFICE OF THE COUNTY ENGINEER

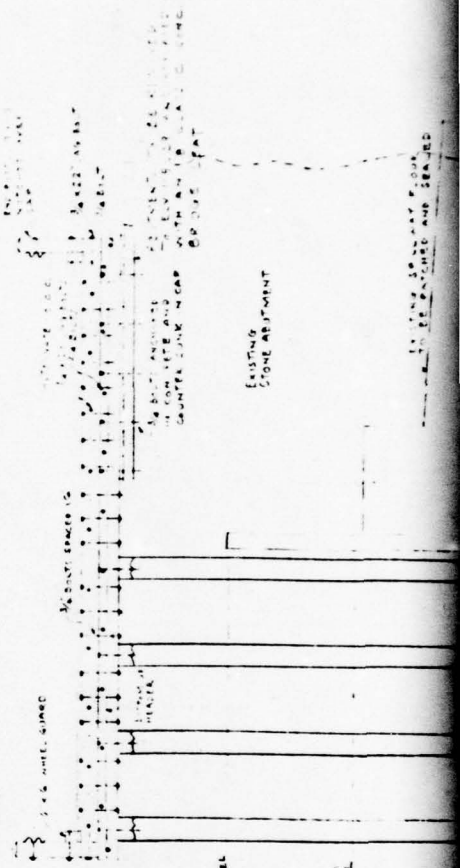
EEHOLD, N.J.

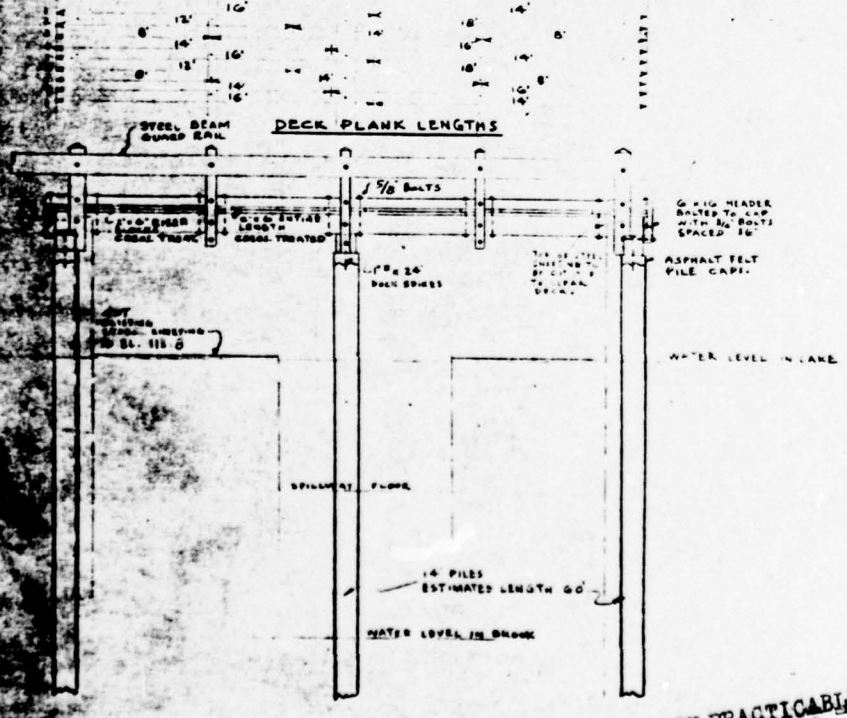
OCT. 28, 1953

PLATE 3

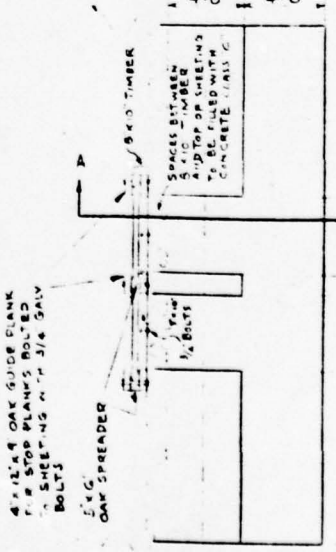
2

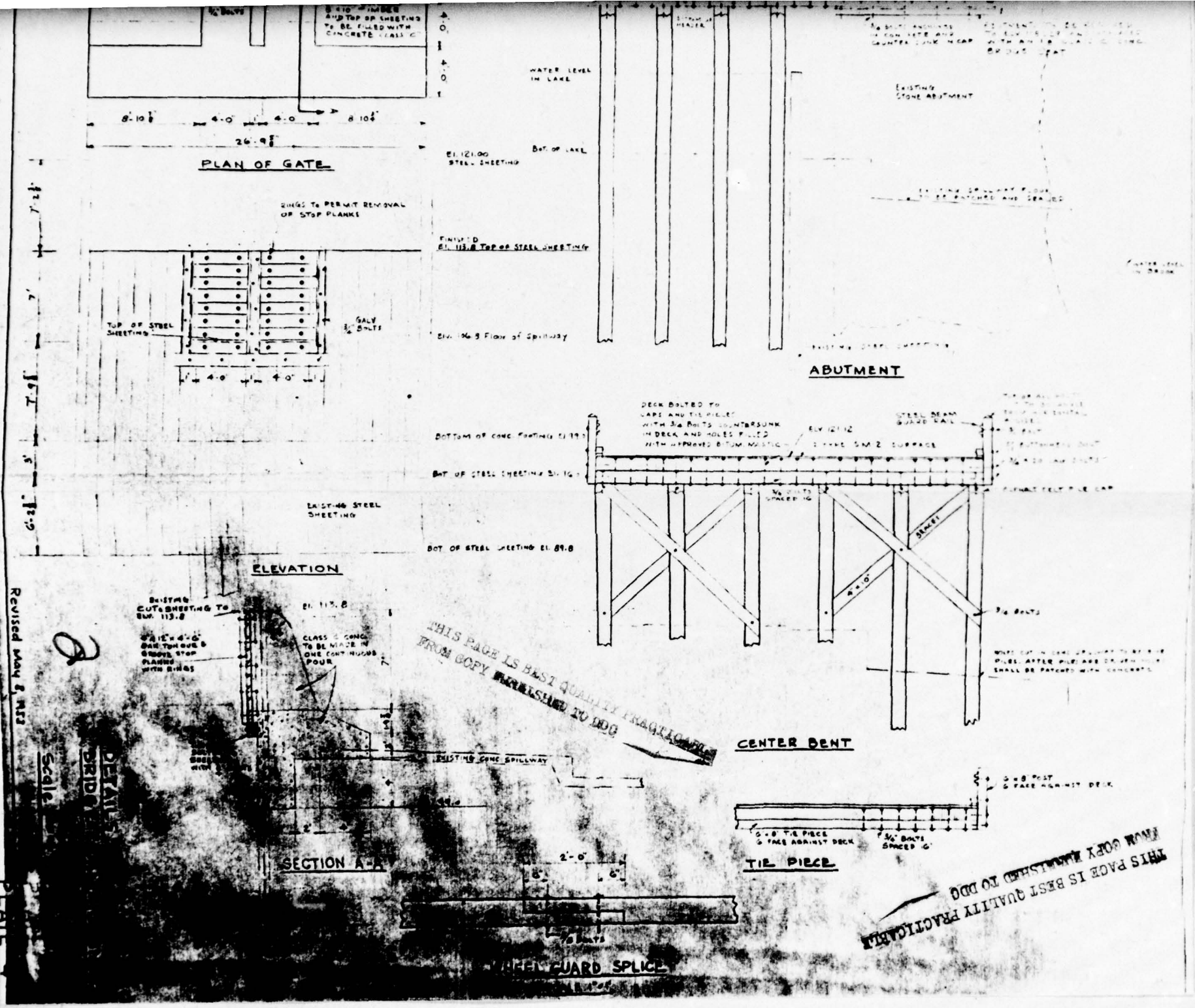






ELEVATION



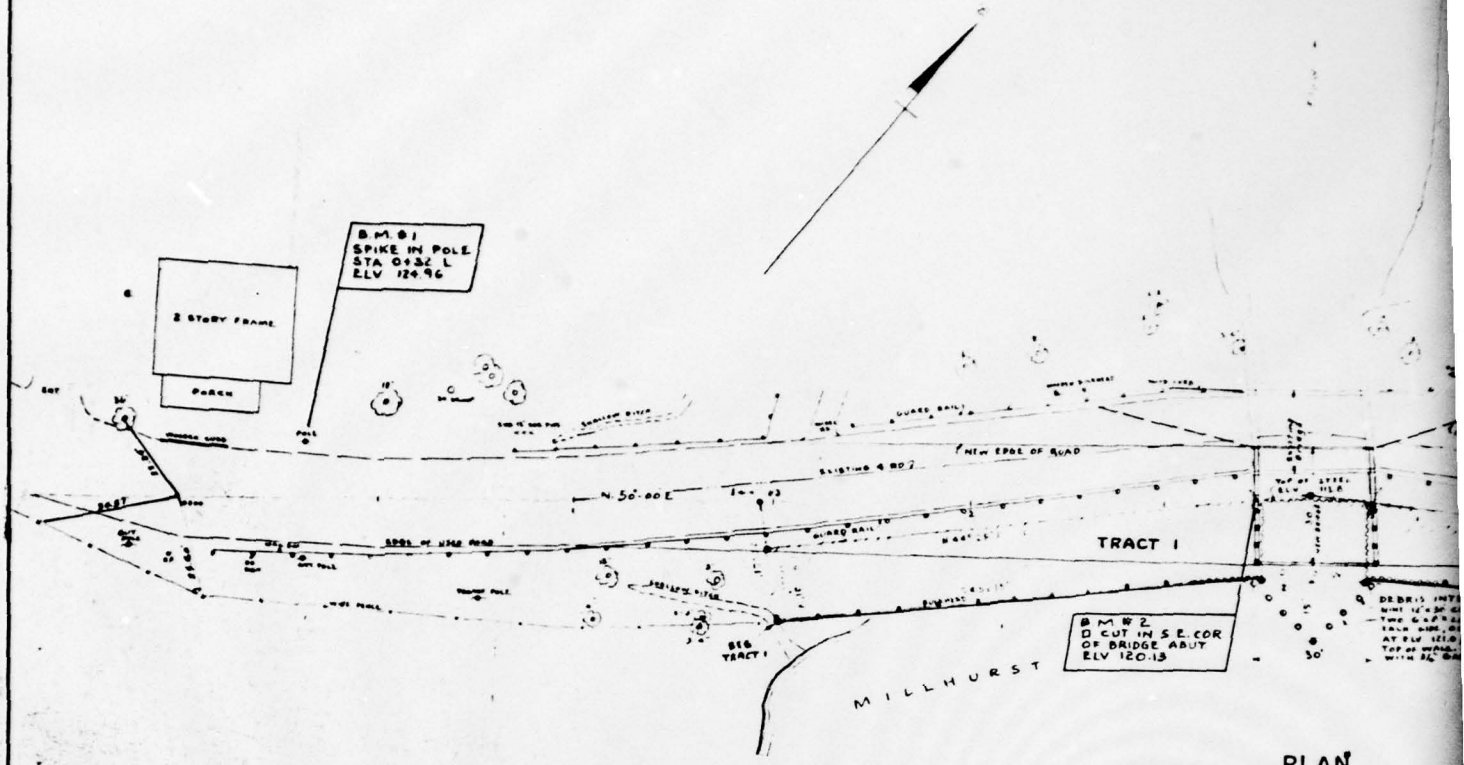


Revised May 8, 1922

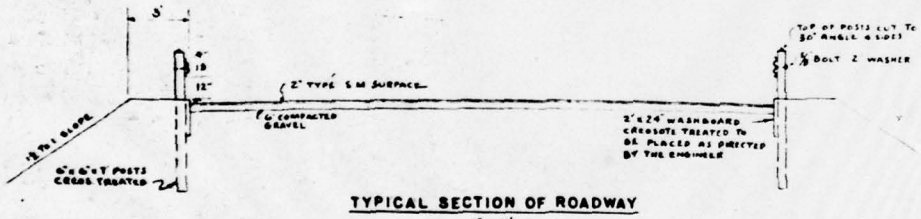
DETAILS OF BRIDGE

Scale

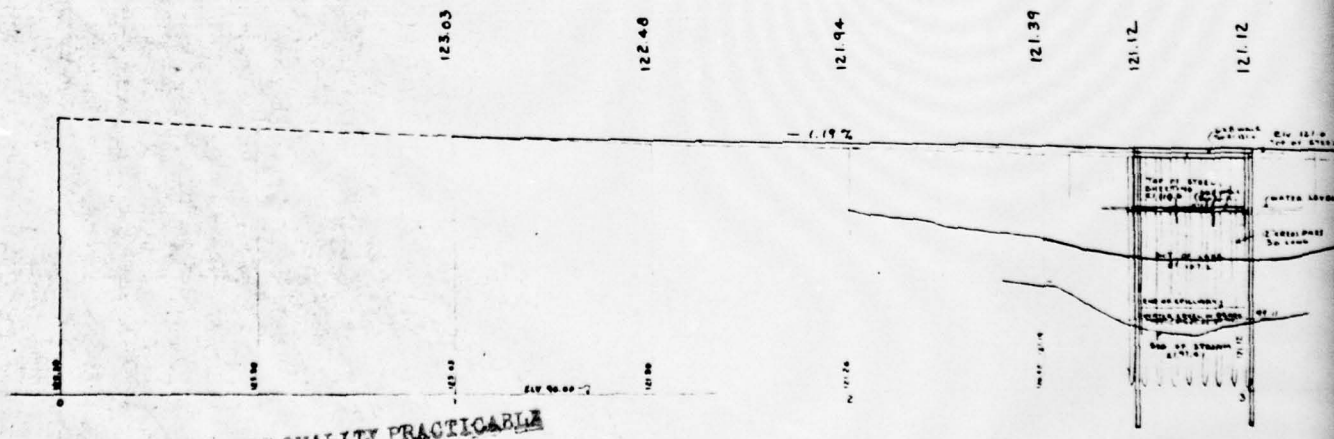
PLATE



PLAN
1" = 20'



TYPICAL SECTION OF ROADWAY
1" = 4'

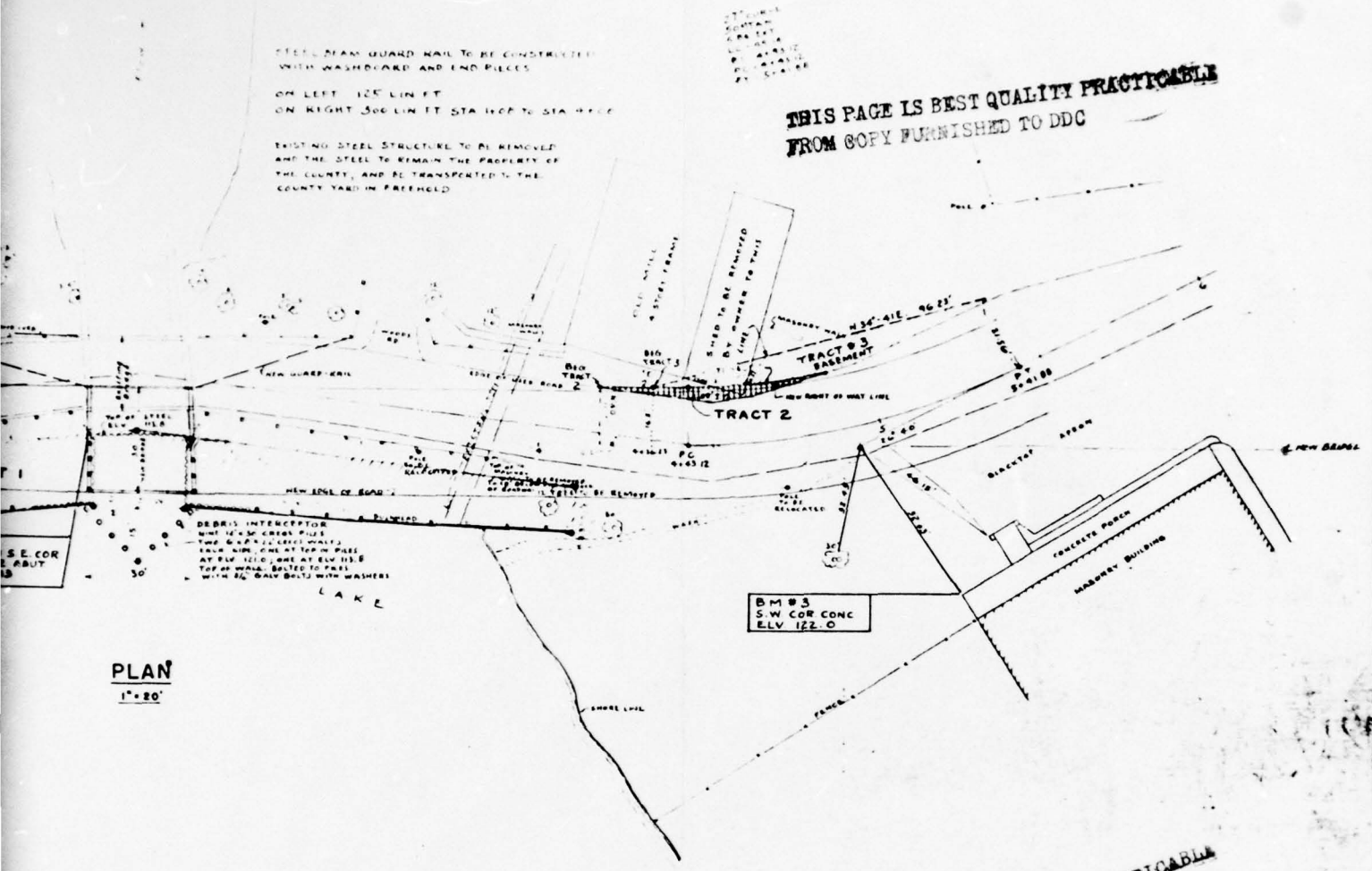


PROFILE
1" = 80' H
1" = 10' V

STEEL BEAM GUARD RAIL TO BE CONSTRUCTED WITH WASHBOARD AND END PIECES

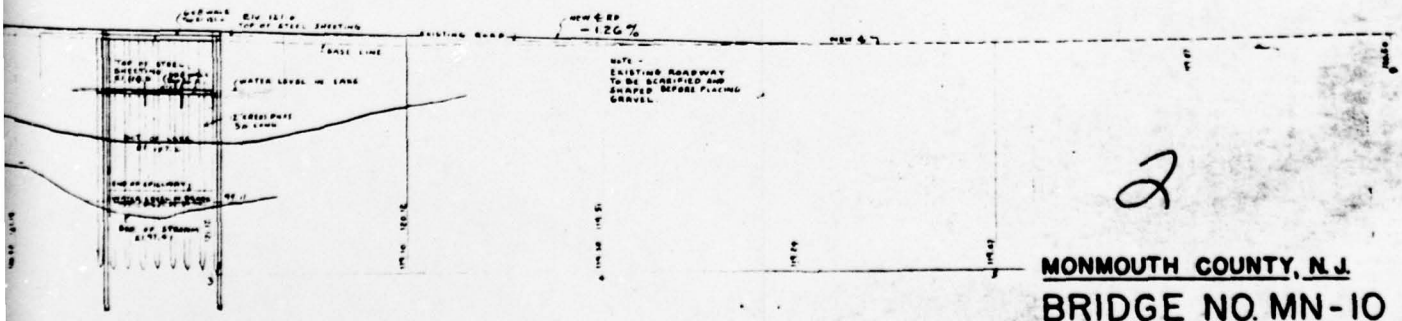
ON LEFT 125 LIN FT
ON RIGHT 300 LIN FT STA 1+00 TO STA 4+25

EXISTING STEEL STRUCTURE TO BE REMOVED AND THE STEEL TO REMAIN THE PROPERTY OF THE COUNTY, AND BE TRANSPORTED TO THE COUNTY YARD IN FREEHOLD



PLAN
1" = 20'

121.12 121.12 120.50 119.87 119.24



PROFILE
1" = 20' H.
1" = 10' V.

2

MONMOUTH COUNTY, N.J.

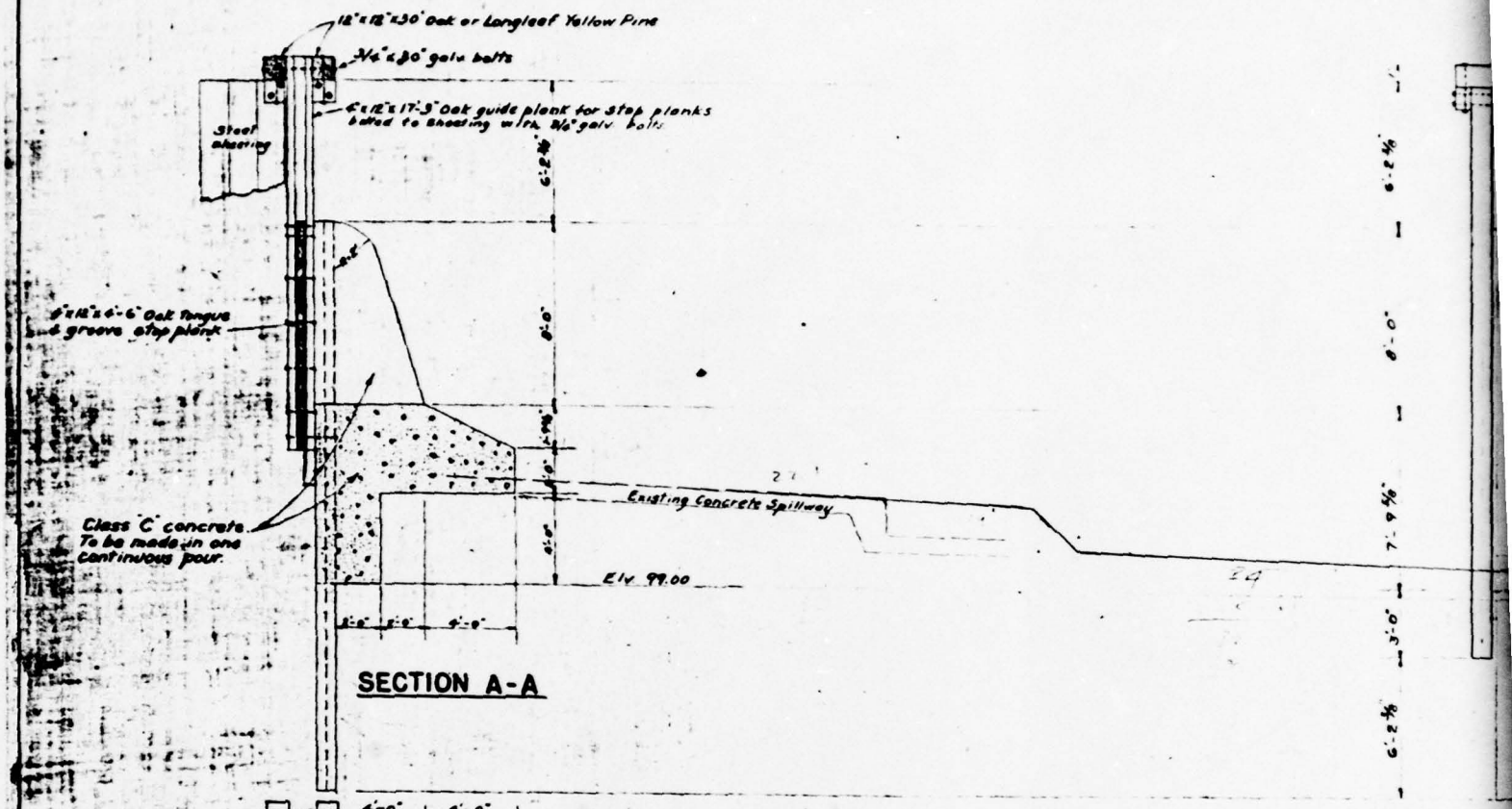
BRIDGE NO. MN-10

MANALAPAN TOWNSHIP

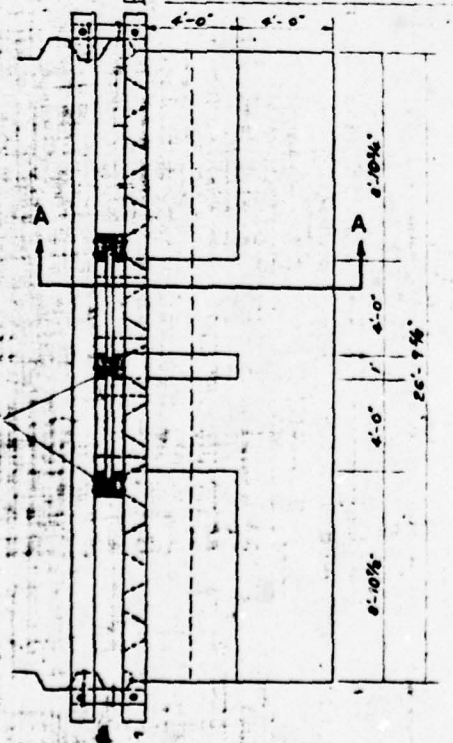
LEO K. MC KEE, COUNTY ENGINEER
SURVEYED FEB. 18, 1953.
Revised May 8, 1953.

APPROVED BY THE DIRECTOR OF DIVISION

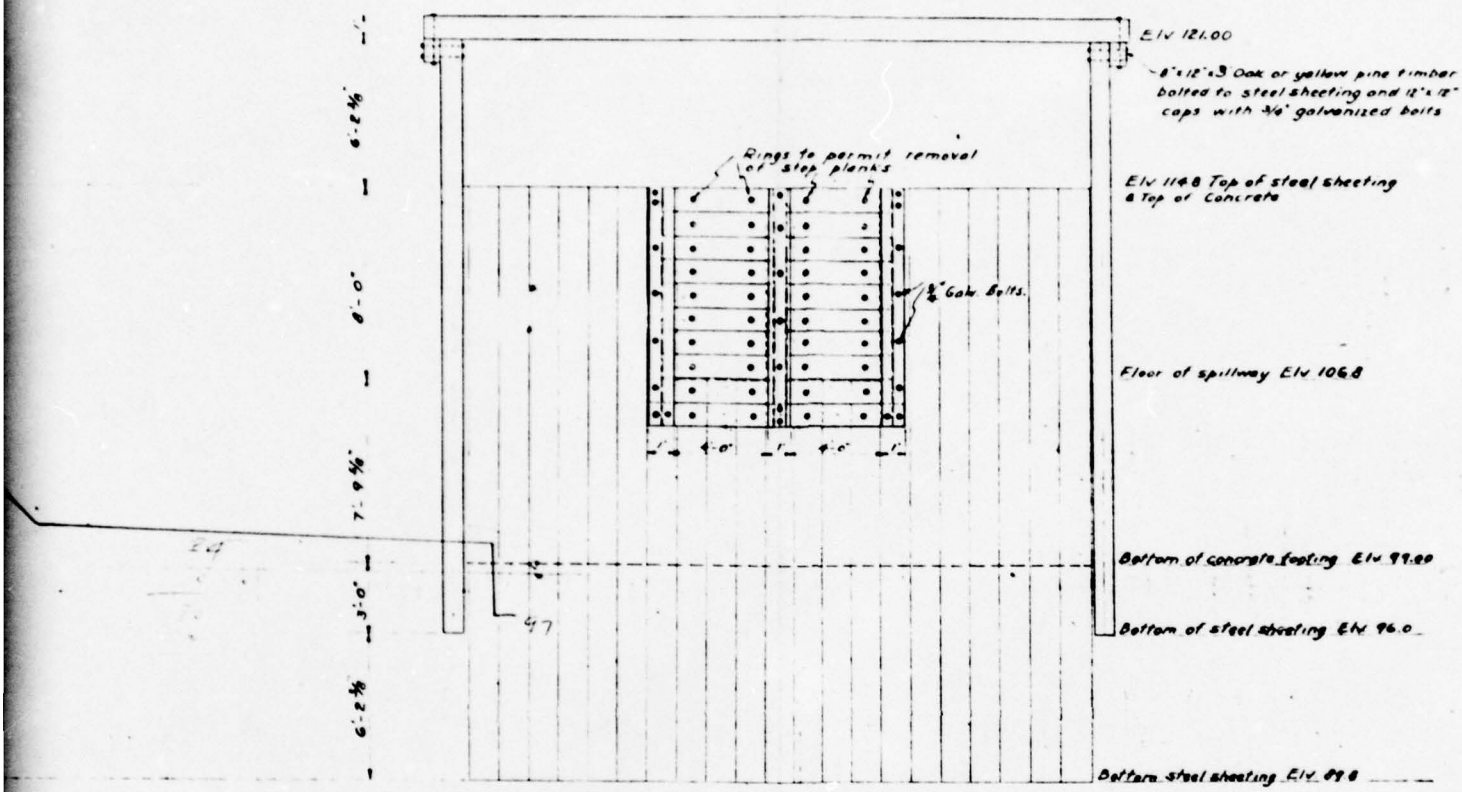
PLATE 5



SECTION A-A



SCALE 1"= 4'



DETAIL OF TIMBER GATE

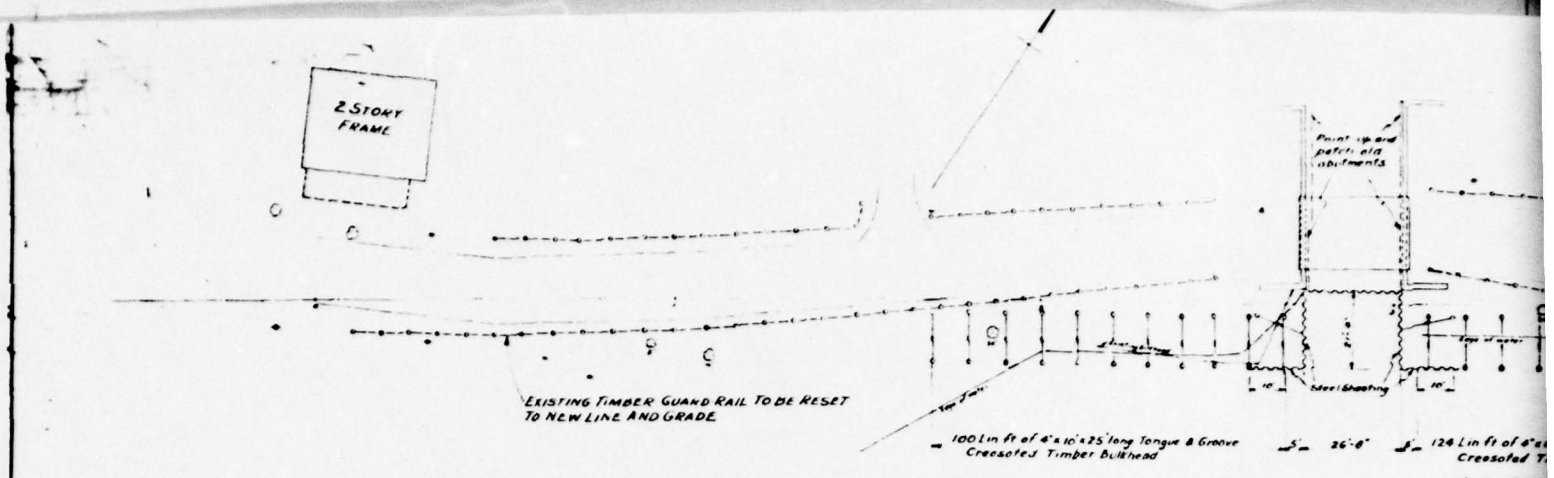
2

PLAN OF PROPOSED FLOOD GATES AT BRIDGE NO. MN-10 MILLHURST MILLING & DRYING CO., INC. MANALAPAN TOWNSHIP MONMOUTH COUNTY, N. J.

1" = 4'

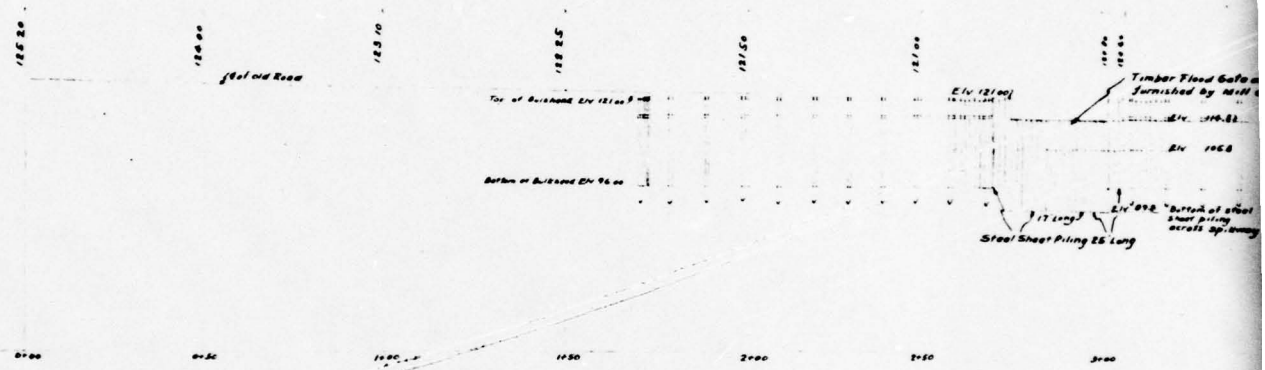
OTIS R SEAMAN, PROFESSIONAL ENGINEER
JULY 23, 1941

PLATE 6

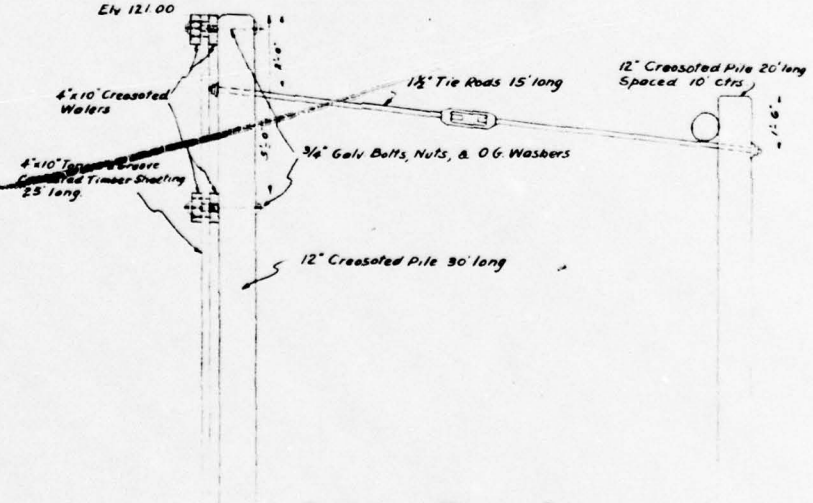


PLAN
Scale 1"-20'

NOTE - TIMB
SHEETING IS
3 BOLTS IN
THE SPACE
SHEETING T

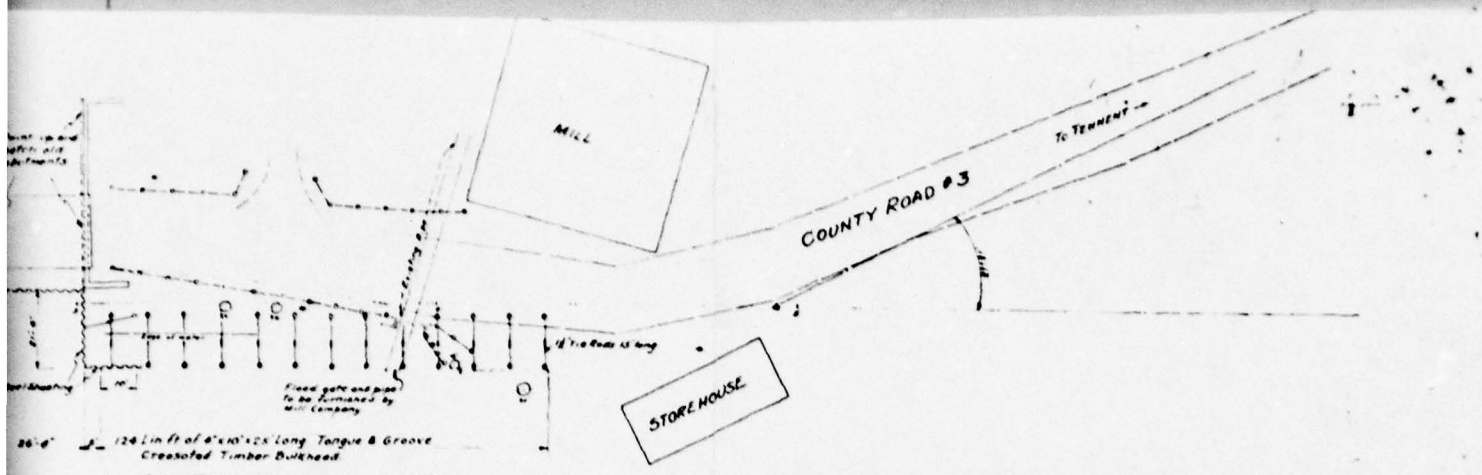


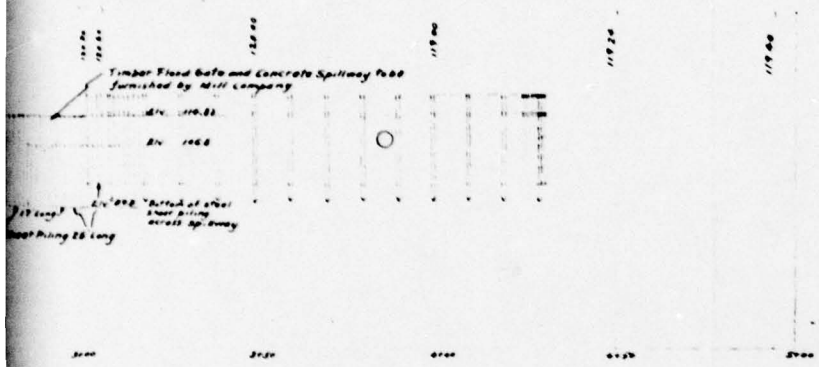
ELEVATION
Scale 1"-20'



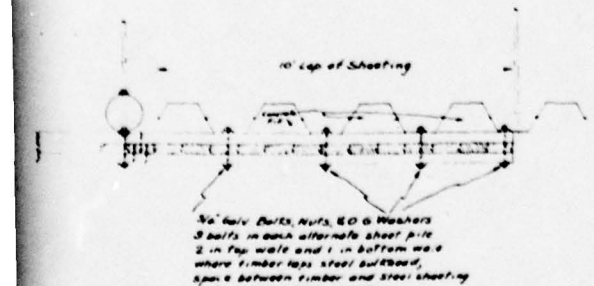
DETAIL OF TIMBER BULKHEAD
Scale 1"-2'

DETA





ATION
1"-20'



DETAIL OF SHEETING LAP
Scale 1"-2'

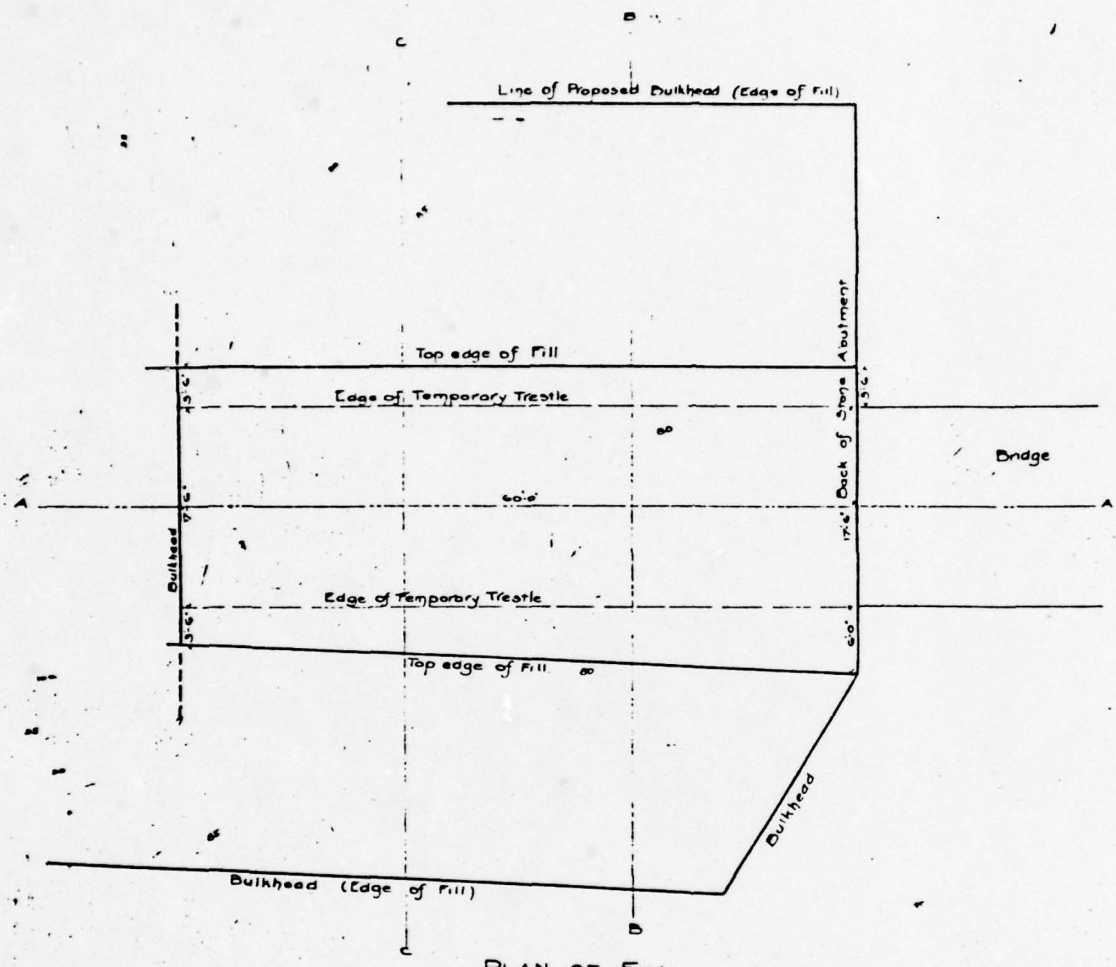
2

MONMOUTH COUNTY, N. J.
BRIDGE NO. MN-10
COUNTY ROAD NO. 3
AT MILLHURST

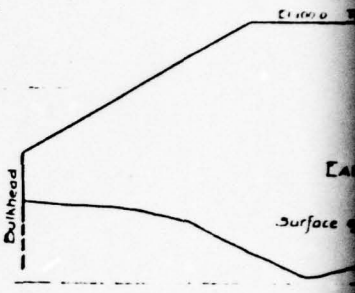
OTIS R. SEAMAN, COUNTY ENGINEER
JUNE 27, 1941.

APPROVED BY THE DIRECTOR OF BRIDGES

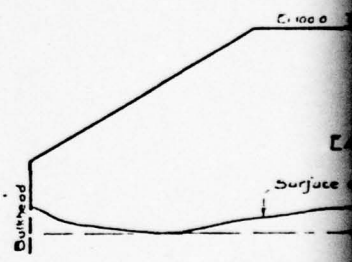
PLATE 7



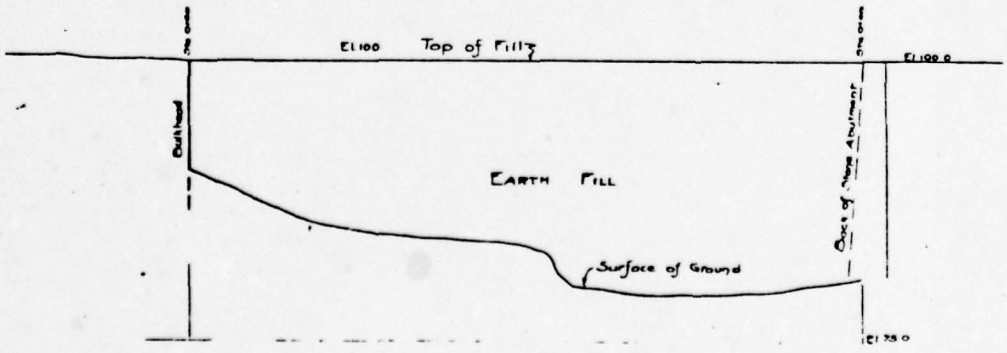
PLAN OF FILL



SECTION



SECTION



SECTION ON LINE A-A

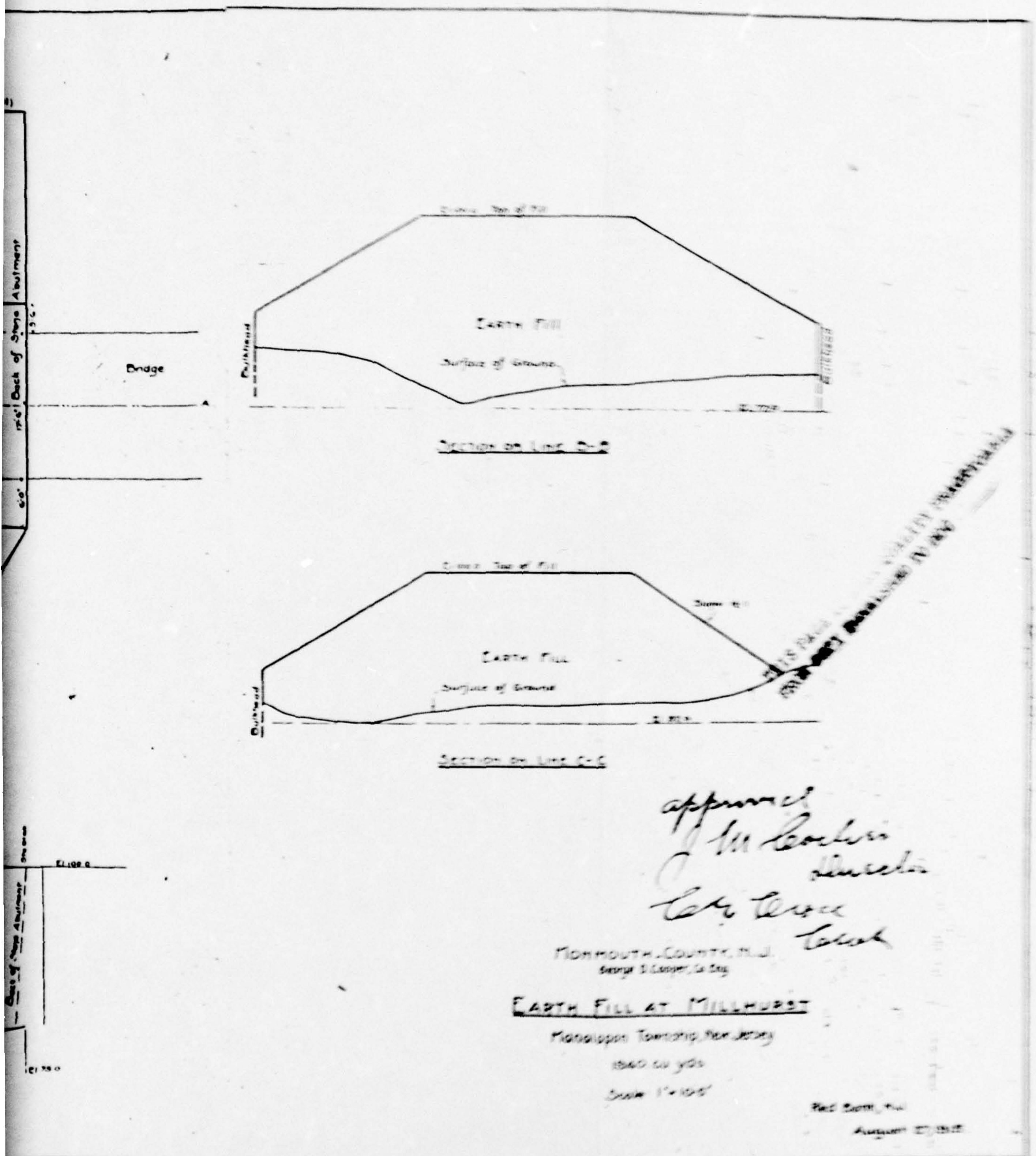

Bridge
Earth Fill
Surface of Ground
Section on Line
Earth Fill
Surface of Ground
Section on Line C-C
Monmouth County, N.J.
Earth Fill at Millhurst
Manalapan Township, New Jersey

PLATE 8

APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

CHECK LIST - ENGINEERING, CONSTRUCTION, MAINTENANCE DATA

CHECK LIST
VISUAL INSPECTION

PHASE I

Name of Dam Millhurst Lake County Monmouth State New Jersey Coordinators NJDEP

Date(s) Inspection April 30, 1979
June 1, 1979 Weather Sunny Temperature 60°

Pool elevation at Time of Inspection 114' M.S.L. Tailwater at time of Inspection 99' M.S.L.

Inspection Personnel:

April 30, 1979

Eugene Koo
Henry King
Chuck Chin

June 1, 1979

Rhon Ernest-Jones

Owner/Representative:

None attended.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SURFACE CRACKS	In the paving of the road which passes over the dam, surface cracks parallel to the road were noted. These were most apparent in an area approximately 80 feet to the left of the left abutment, where the timber bulkhead on the upstream face was seen to be tilting outwards.	The cracks may be caused by movement of the bulkhead anchors. Stability of the entire bulkhead should be checked.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No evidence of movement or cracking was noted at the toe.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Erosion on the downstream face is severe. A makeshift plywood support 20 feet long, has been placed 100 feet left of the left abutment where the embankment fill has been eroded. The downstream face is extremely irregular and steep (steeper than 2 on 1) throughout and much evidence of sloughing and erosion was found.	Replace material that has been eroded with quarry-run stone or gravel, properly keyed, to a slope no steeper than 2H:1V.
VERTICAL & HORIZONTAL ALIGNMENT OF THE CREST	The timber and steel sheeting bulkhead on the upstream face shows a tilt of varying severity towards the lake. To the right of the right abutment, there is a general outward tilt and 80 feet to the left of the left abutment the worst misalignment occurs. Settlement of the road is greatest in these areas and adjacent to the bridge, embankment settlement is also apparent.	Horizontal alignment of the crest, and vertical alignment of the bulkhead should be regularly monitored.
RIPRAP FAILURES	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
VEGETATION	A heavy covering of trees and low vegetation exists on the downstream face. The root system appears to be retarding erosion, but causing instability to the spillway abutments.	Clear the downstream face of trees.
JUNCTION OF EMBANKMENT AND ABTUMENT, SPILLWAY AND DAM	Erosion behind the left abutment is severe, and a gulley to drain the road has formed. This gulley is evidently used as a footpath. The road shoulder next to both abutments has been reinforced with blacktop. Erosion of embankment toe adjacent to both abutments has been severe, resulting in undermining and settlement of the masonry.	Replace material that has been eroded with quarry-run stone properly keyed. Underpin the abutment toes with concrete.
ANY NOTICEABLE SEEPAGE	The only noticeable seepage was adjacent to the left abutment where water was flowing.	
STAFF GAGE AND RECORDER	None.	
DRAINS	None.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE WEIR	Spillway consists of two concrete ogee weirs separated by two 4-foot wide stop-plank structures. Flow over the ogees and stop-planks was smooth indicating good horizontal alignment. Leakage not detectable as d/s surface was obscured by flow. Erosion has occurred at the junction between spillway and wingwalls.	Repoint masonry at junction with spillway.
APPROACH CHANNEL	The approach channel is protected against large debris by an interceptor, which is functioning adequately. Channel sides are formed by steel sheet-piling which shows no undue corrosion or misalignment.	
DISCHARGE CHANNEL	The spillway apron descends in two steps to the downstream channel, and is in satisfactory condition. Erosion has occurred at the junction of apron and wingwalls. Concrete repairs of more recent construction have also been eroded by the action of water and by tree roots. Both wingwalls are severely undermined and deteriorated at the toe, with many masonry blocks missing. Some new pointing of the wingwalls was evident.	Repair deteriorated masonry and provide concrete underpinning to wingwall toes. Repoint as needed.
BRIDGE AND PIERS	The timber bridge and intermediate support appear to be in satisfactory condition. A crack in the right abutment/wingwall extends from the apron to 2" wide at the top of the wall at 45°, indicating major settlement of the d/s part of the abutment on that side.	
FOUNDATION	According to the U.S.G.S., the spillway is founded on Red Bank and Tinton Falls sand.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CRACKING & SPALLING OF CONCRETE SURFACES IN STILLING BASIN	The concrete repairs between wingwalls and apron junction are eroded. The end of the apron is undermined, but otherwise it is in good condition.	
INTAKE STRUCTURE	None.	
OUTLET STRUCTURE	None.	
OUTLET FACILITIES	Two 4' wide stop-plank structures (net length 7.7') at center of spillway. 54" diameter penstock (formerly feeding the mill-works) is visible at the base of the d/s retaining wall near the mill. This outlet is silted up and not operable.	
EMERGENCY GATE	Remove stop-planks manually.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
MONUMENTATION/SURVEYS		
None		Install a nearby benchmark.
OBSERVATION WELLS		
None		
WEIRS		
None		Install gages to measure lake and tailwater elevations.
PIEZOMETERS		
None		
OTHERS		
None		

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SLOPES	Slope moderate along the rim of the lake, and covered with a heavy growth of brush and trees.	
SEDIMENTATION	Some sedimentation in evidence, particularly near the dam, where weed growth is widespread.	
USE	Recreation.	
SHORE-LINE BUILDINGS	Millhurst Mill on the right bank. Some residential properties on the left bank near the road.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONDITION (OBSERVATIONS, DEBRIS, ETC.)	Natural channel meandering, with heavy growth of brush and trees on overbank. Waterway near spillway is poorly defined and the stream is full of debris of all kinds. Fallen trees across the stream have broken away the bank.	
SLOPES	Slopes are moderate and covered with a heavy growth of trees and brush.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	No houses are known to exist immediately downstream of the dam, as far as Route 33. The old mill building is disused.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Available, on included drawings.
REGIONAL VICINITY MAP	Available - County Map U.S.G.S. Quadrangle Sheet for Adelphia.
CONSTRUCTION HISTORY	From microfiche on file at NJDEP.
TYPICAL SECTIONS OF DAM	Limited data available, on included drawings.
HYDROLOGIC/HYDRAULIC DATA	Very little available on file at NJDEP.
OUTLETS - PLAN	None.
- DETAILS	None.
- CONSTRAINTS	None.
- DISCHARGE RATINGS	None.
RAINFALL/RESERVOIR RECORDS	None.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
DESIGN REPORTS	None.
GEOLOGY REPORTS	U.S.G.S. Quadrangle: Geological overlay sheet. Rutgers Unversity Report for Monmouth County.
DESIGN COMPUTATIONS	None.
HYDROLOGY & HYDRAULICS	Spillway capacity calculation available. (NJDEP Microfiche).
DAM STABILITY	None.
SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS	Some field inspection report sheets on file at the NJDEP.
BORING RECORDS	Some field inspection report sheets on file at the NJDEP.
LABORATORY	Some field inspection report sheets on file at the NJDEP.
FIELD	Some field inspection rpeort sheets on file at the NJDEP.
POST-CONSTRUCTION SURVEYS OF DAM	1953 Topographic Survey (Plates 3 & 5).
BORROW SOURCES	Not known.
SPILLWAY PLAN - SECTIONS	Available as reconstructed in 1953.
- DETAILS	Available as reconstructed in 1953.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
OPERATING EQUIPMENT PLANS AND DETAILS	Not available.
MONITORING SYSTEMS	Not available.
MODIFICATIONS	None proposed since reconstruction in 1953.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Redesign and reconstruction drawings available, dated 1953, included.
PRIOR ACCIDENTS OF FAILURE OF DAM	None.
- DESCRIPTION	None.
- REPORTS	None.
MAINTENANCE OPERATION RECORDS	None.

APPENDIX B

PHOTOGRAPHS

(Photo No. 1 taken January 30, 1979:

remainder on April 30 and June 1, 1979)

Photo No. 1 - Overall view of spillway, apron and bridge structure from downstream. Note the cracking and undermining of the wingwalls.

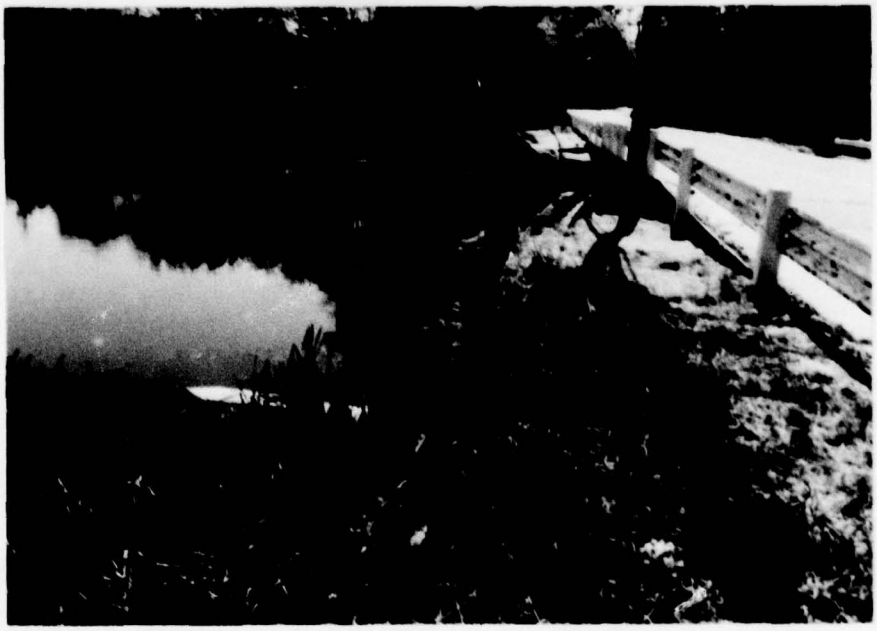


Photo No. 2 - Overall view of upstream face of dam. Note the debris interceptor upstream of the spillway.

Photo No. 3 - View of concrete ogee weirs with a double stop-plank gate in the center. Note the timber bridge support and the timber bridge deck.

Photo No. 4 - View of right masonry wingwall showing cracking, undermining and overall deterioration. Note the extensive 45° crack on the right of the picture.

Photo No. 5 - View of left wingwall, showing seepage at the toe of the embankment. The wingwall has been undermined and the concrete repair is also deteriorated. Tree roots are promoting deterioration.

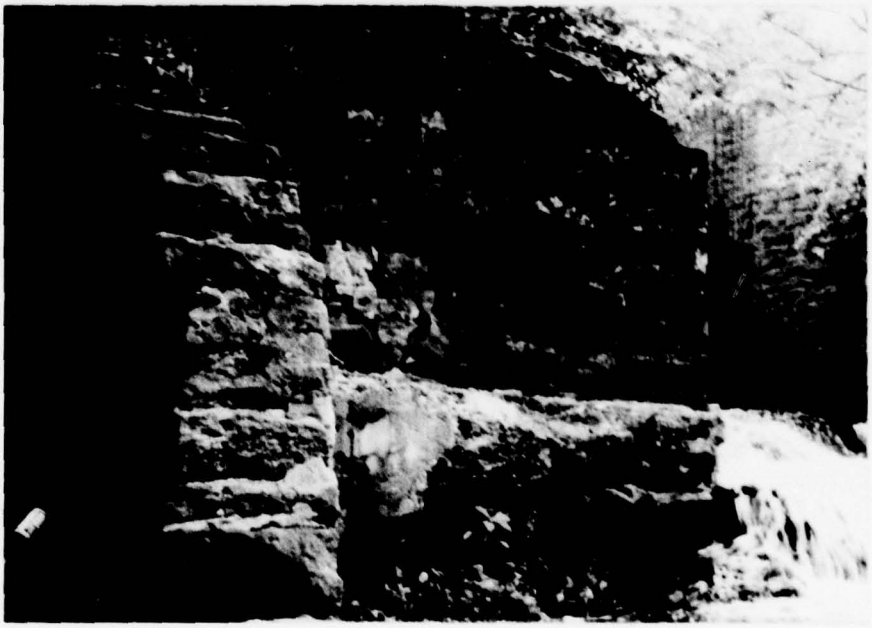


Photo No. 6 - Detail of toe of right wingwall showing severe settlement cracks and undermining.

Photo No. 7 - View of downstream embankment face adjacent to the left wingwall. Note the heavy growth of trees and the extent of erosion behind the wall.

Photo No. 8 - View of the disused mill-works to the right of the spillway.

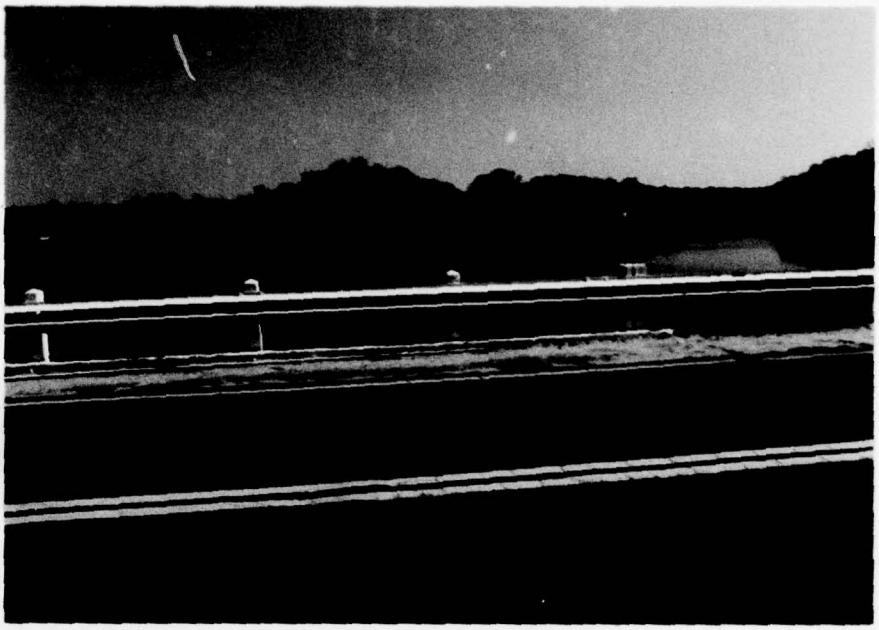


Photo No. 9 - General view of Millhurst Lake looking upstream. Note the moderate, wooded slopes and the accumulation of silt and weed at the rim.

Photo No. 10 - View of the downstream channel showing its irregularity and cover of vegetation. Note the fallen trees.

APPENDIX C

SUMMARY OF ENGINEERING DATA

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

Name of Dam: Millhurst Lake Dam

Drainage Area Characteristics: Rural, lightly wooded and minor residential.

Elevation Top Normal Pool (Storage Capacity): 113.8' (58 acre-feet)

Elevation Top Flood Control Pool (Storage Capacity): N/A

Elevation Maximum Design Pool: (SDF) 125.1' MSL (843 acre-feet)

Elevation Top Dam: (overflow) 120.4' MSL (360 acre-feet)

SPILLWAY CREST

a. Elevation 113.8'

b. Type Two concrete spillways of ogee type.

c. Width 3'

d. Length 26.8'

e. Location Spillover Full length

f. No. and Type of Gates Double stop-plank gate, part of spillway.

OUTLET WORK

a. Type Double stop-plank gate (7.7' total length)

b. Location Center of spillway

c. Entrance Inverts 114.0' (with all planks)

d. Exit Inverts 113.8'

e. Emergency Draindown Facilities Remove stop-planks

HYDROMETEOROLOGICAL GAGES

a. Type N/A

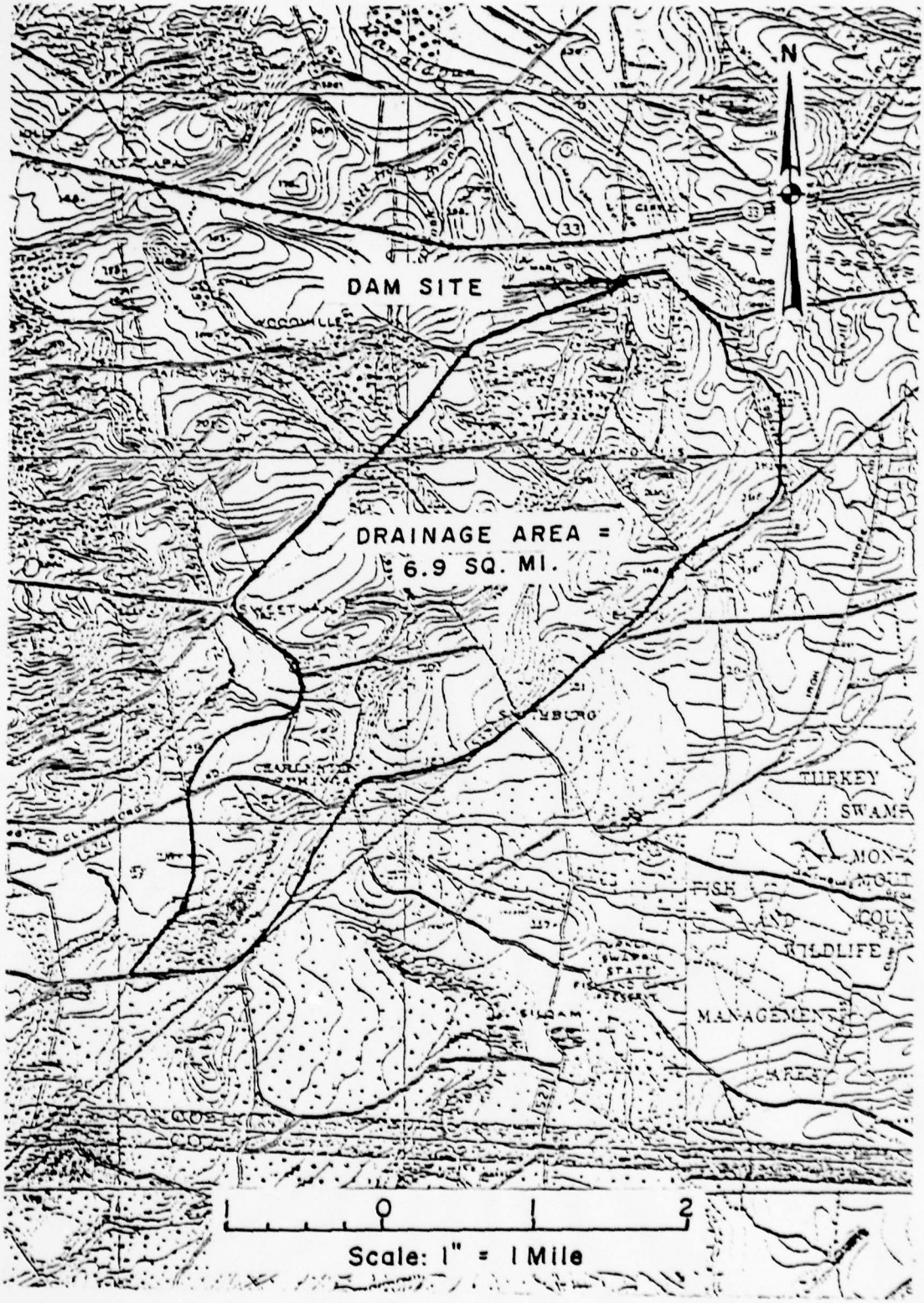
b. Location N/A

c. Records N/A

MAXIMUM NON-DAMAGING DISCHARGE 1350 cfs.

APPENDIX D

HYDROLOGIC COMPUTATIONS



MILLHURST LAKE DAM
DRAINAGE BASIN

SIZE CLASSIFICATION

SURFACE AREA OF MAIN IMPOUNDMENT	18 ± ACRES
AVERAGE DEPTH AT LAKE	7' ±
STRUCTURAL HEIGHT OF DAM	20' ±
SIZE CLASSIFICATION	SMALL

HAZARD POTENTIAL CLASSIFICATION

HEAVILY TRAVELED ROAD THAT IS PART OF THE IMPOUNDMENT STRUCTURE

HAZARD POTENTIAL CLASSIFICATION	HIGH
RECOMMENDED SDF	½ PMF

HYDROLOGIC ANALYSIS

THE HEC-1 DB WILL BE USED TO ROUTE THE FLOOD USING SCS TRIANGULAR UNIT HYDROGRAPH WITH CURVILINEAR TRANSFORMATION

D.A. = 6.9 SQ. MI.

PRECIPITATION

FROM FIG 15. ZONE G (REF. "DESIGN OF SMALL DAM" 1977"

PROBABLE MAX. PRECIPITATION = 26" FOR 6-HR DURATION

AND 10-SQ. MI - AREA

DURATION (HRS)	% OF PMP
6	100
12	109
24	117

VALUES ARE REDUCED by 20% to ACCOUNT FOR MIS ALIGNMENT OF BASIN & STORM ISOHEYTALS

INFILTRATION DATA

DRAINAGE CONSISTS 2/3 of M-27, 1/6 M27 1/6 M 23

(REF 'ENGINEERING SOIL SURVEY OF-OF - MONMOUTH COUNTY, RUTGERS UNIVERSITY')

HYDROLOGIC SOIL GROUP	C
USE INITIAL INFILTRATION	1.0 inch
USE CONSTANT MINIMUM RATE	0.12 inch/hr

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT MILL HURST LAKE — SHEET NO. 3 OF
JOB NO. 10-A20-01
COMPUTED BY E.K. CHECKED BY — DATE

TIME CONCENTRATION

1) ESTIMATING T_C FROM VELOCITY ESTIMATE & WATERCOURSE LENGTHS

	SLOPE	VEL.	REMARK
OVERLAND FLOW	25/1000	1.5	PASTURE upland
1st REACH	65/26000	1.0	NEGLECTS FLOW THRU LAKE

$$T_C = \frac{1000}{1.5 \times 3600} + \frac{26000}{1 \times 3600} = 7.41 \text{ hrs}$$

2) ESTIMATING T_C FROM VELOCITY & WATERCOURSE LENGTHS ASSUMING TRAVEL THRU RESERVOIR IS AT SAME VELOCITY AS THE STREAM CHANNEL

$$\frac{27000}{1.0 \times 3600} = 7.5 \text{ hr}$$

3) FROM NOMOGRAPH "DESIGN OF SMALL DAM"

$\Delta H = 90'$ $L = 27000'$ $T_C = 3.0$ hr

4) USING THE F.A.A. FORMULA FOR SURFACE FLOW (AIRPORT DRAINAGE 1970)

$$T_{C(MIN)} = \frac{1.8\,(1.1C)\sqrt{D}}{\sqrt[3]{S}}$$

$D = 27000'$
$C = 0.35$ (URBAN RESIDENTIAL)
$S = \frac{90}{27000} = 0.33\%$

$$T_C = \frac{1.8\,(1.1-0.35)\sqrt{27000}}{\sqrt[3]{0.33\,(60)}} = 5.33 \text{ hr}$$

TIME OF CONCENTRATION (CONTINUED)

5. Kirpich

$$T_c = 0.0078\, K^{.77} \qquad K = \frac{L}{\sqrt{S}} \qquad S = \frac{H}{L}$$

$$T_c = 0.0078 \left(\frac{30{,}000}{\sqrt{\frac{95}{30000}}} \right)^{.77} = 3.34 \text{ hr}$$

6 G. B. Williams Flood committee

$$t = 0.908\, L^5 \sqrt{\frac{1}{FD}}$$

WHERE t IS THE PERIOD IN HOURS
L IS THE LENGTH OF THE CATCHMENT IN MILES
D IS THE DIAMETER IN MILES OF A CIRCLE HAVING THE SAME AREA
F IS THE CATCHMENT SLOPE EXPRESSED IN %

$$t = 0.908 \left(\frac{27000}{5280} \right)^5 \sqrt{\frac{1}{0.33 \times 2.96}} = 4.66 \text{ hr}$$

USE $T_c = 5.2$ hr

$$\text{LAG} = 0.6\, T_c = 3.12 \text{ hr.}$$

LAG = 3.12 HR

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT MILLHURST
COMPUTED BY EK CHECKED BY

SHEET NO. 5 OF
JOB NO. 10-A20-01
DATE

ELEVATION - AREA - CAPACITY RELATIONSHIP

INFORMATION OBTAINED FROM U.S.G.S.

ELEV.	106.8*	113.8	120	130
SURFACE AREA (AC)	0	24.8	67.	229.6

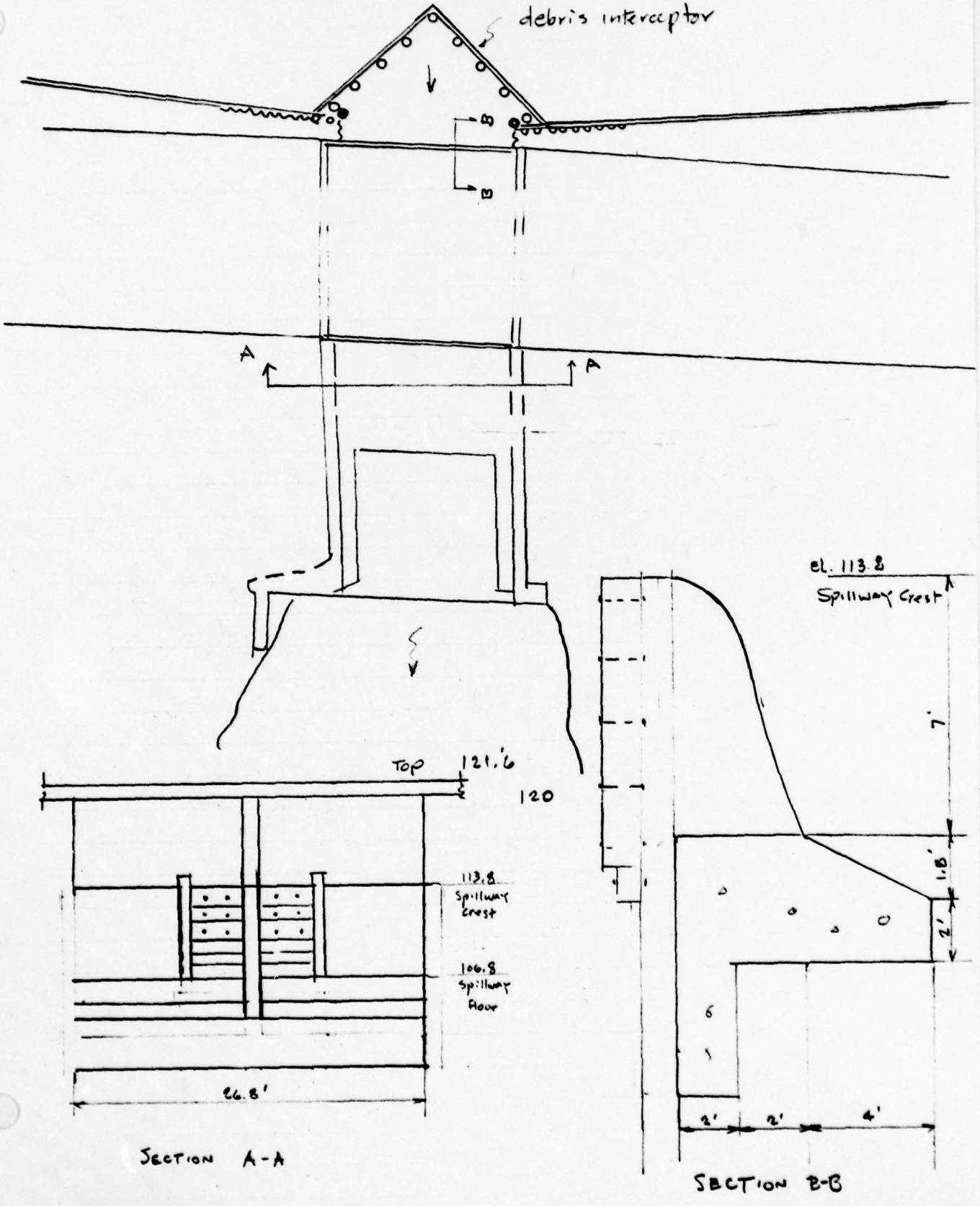
* BOTTOM OF LAKE AT SPILLWAY

HEC-1 DB PROGRAM WILL DEVELOP STORAGE CAPACITY FROM SURFACE AREA & ELEVATIONS

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT: MILLHURST LAKE, N.J.
COMPUTED BY: E.K. CHECKED BY:

SHEET NO. 6 OF
JOB NO. 10-A20-01
DATE

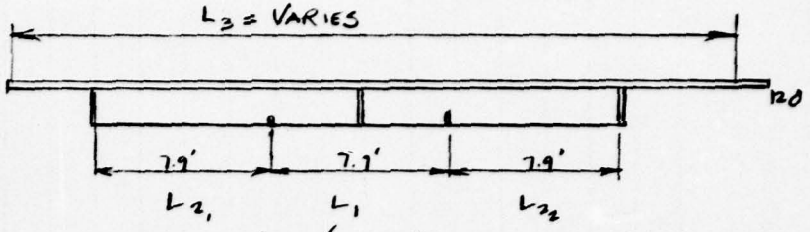


FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT Miniature Lake
COMPUTED BY [illegible] CHECKED BY
JOB NO. 10-120-01
DATE
SHEET NO. 1 OF

SPILLWAY AND OVERTOPPING RATING CURVE

C_1 = 3.3 FOR SHARP CREST WEIR
C_2 = 3.3 to 3.81 FOR Uncontrolled Ogee
C_3 = 2.65 FOR OVER ROADWAY
From 5-96 King & BRATER



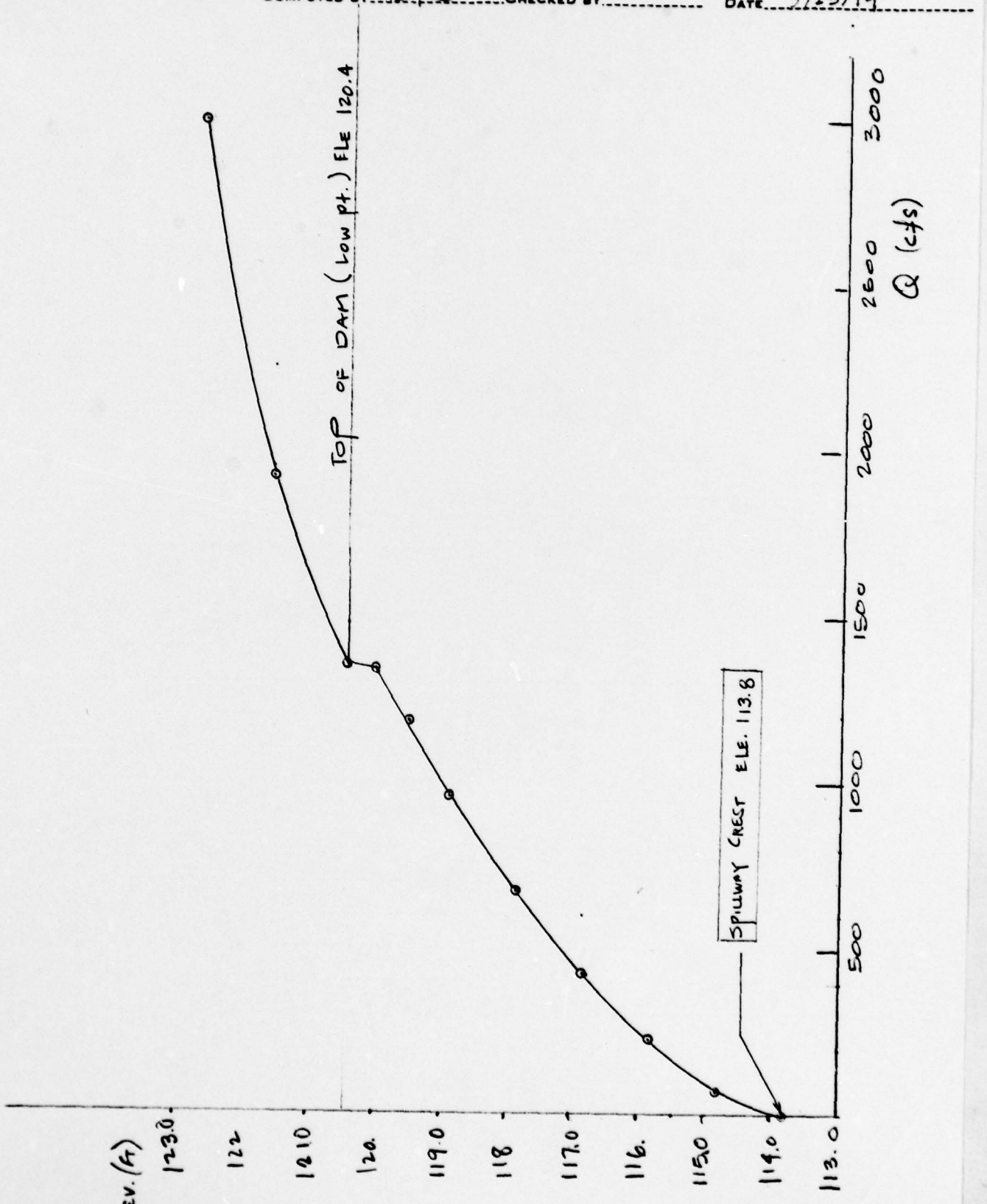
L_1 = 7.7' (NET)
L_2 = 15.8 (NET)
$L_2' = L_1 + L_2 = 23.5'$
$C_2' = 0.63$

The loss due to debris interceptor is neglected
The total design spillway length is 26.7' (from file),
but the total net spillway length is 7.7 + 15.8 = 23.5'

ELE.	H_1 ft	H_2 ft	H_3 ft	L_1 ft	L_2 ft	L_3 ft	C_1	C_2	C_3	$Q = C_1 L_1 H_1^{1.5} + C_2 L_2 H_2^{1.5}$ for ELE up to 120. FOR ELE > 120.0 $Q = \frac{2}{3}\sqrt{2g} C_2' L_2' (H_2^{1.5} - H_2'^{1.5}) + C_3 L_3 H_3^{1.5}$ cfs
113.8										=0
114.8	1.0	1.0		7.7	15.8		3.3	3.3		25 + 52 = 77
115.8	2.0	2.0		7.7	15.8		3.3	3.97		72 + 155 = 227
116.8	3.0	3.0		7.7	15.8		3.3	3.61		132 + 296 = 428
117.8	4.0	4.0		7.7	15.8		3.3	3.73		203 + 472 = 675
118.8	5.0	5.0		7.7	15.8		3.3	3.82		284 + 675 = 959
119.5	5.7	5.7		7.7	15.8		3.3	3.88		346 + 832 = 1180
120.0	6.2	6.2		7.7	15.8		3.3	3.88		392 + 951 = 1348
two pt.	120.4	H_2 6.6 / H_2' 0.4			L_2' 23.5			C_2' 0.643		0 + 1350 = 1360
	121.6	7.8 / 1.6	1.2		23.5	91		0.643	2.65	1597 + 317 = 1914
	122.7	8.9 / 2.7	2.3		23.5	124		0.643	2.65	1788 + 1146 = 2934
	123.0	9.2 / 3.0	2.6		23.5	150		0.63	2.65	1799 + 1666 = 3465
	124.0	10.2 / 4.0	3.6		23.5	184		0.63	2.65	1947 + 3331 = 5278
	125.1	11.3 / 5.1	4.7		23.5	191		0.63	2.65	2096 + 5168 = 7264

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

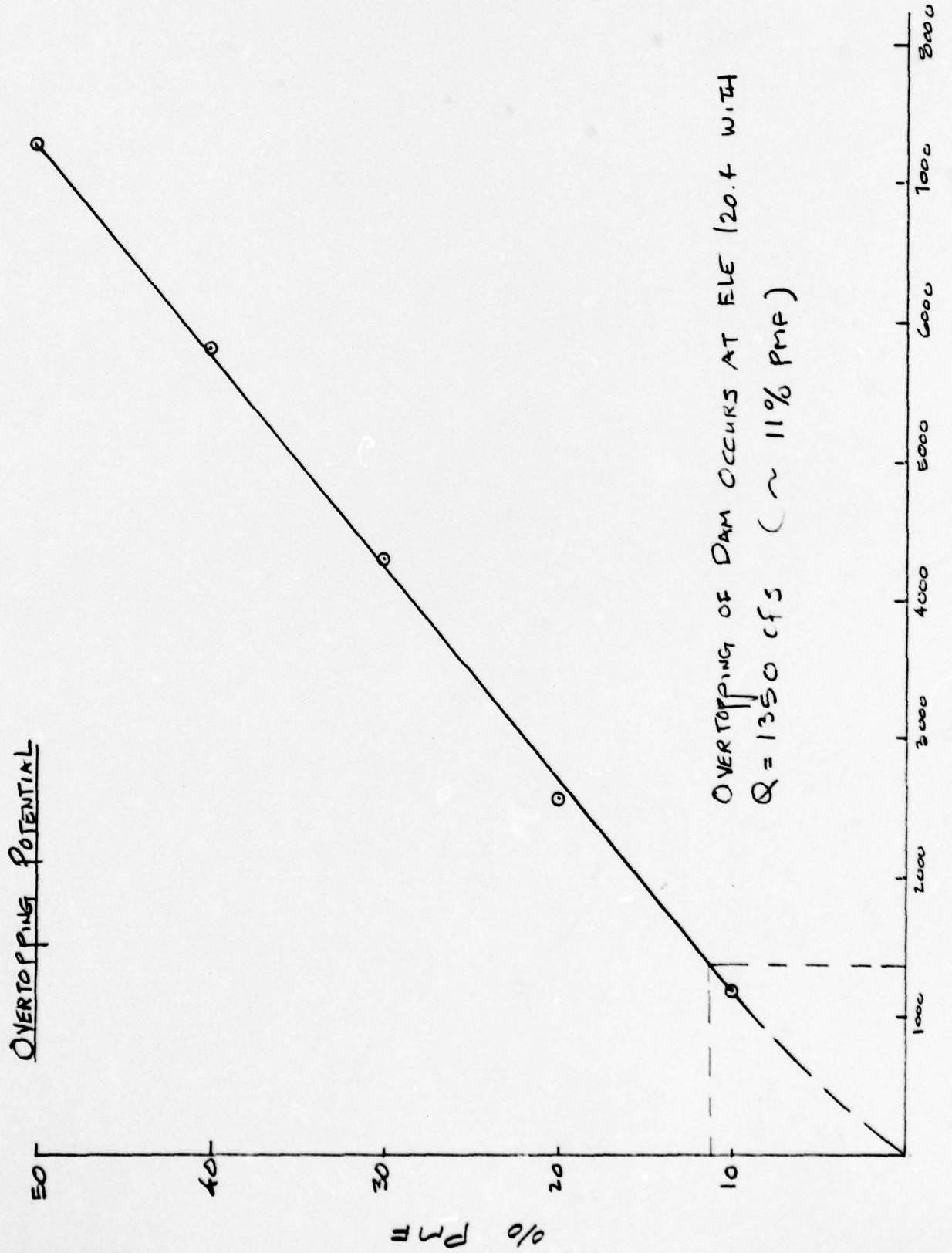
SUBJECT MILLHURST LAKE
COMPUTED BY R.K. CHECKED BY
SHEET NO. 8 OF
JOB NO. 10-A20-01
DATE 5/23/79



FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT MILLHURST LAKE
COMPUTED BY EK CHECKED BY

SHEET No. 9 OF
JOB No. 10-420-01
DATE



FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT LAKE MILLHURST DAM — SHEET NO. 10 OF
JOB NO. 10-A20-01
COMPUTED BY RK CHECKED BY — DATE Aug. 1979

DRAWDOWN TIME COMPUTATION Based on Removal of Stop Logs

Normal Pool Elev to start 113.8
To 106.8

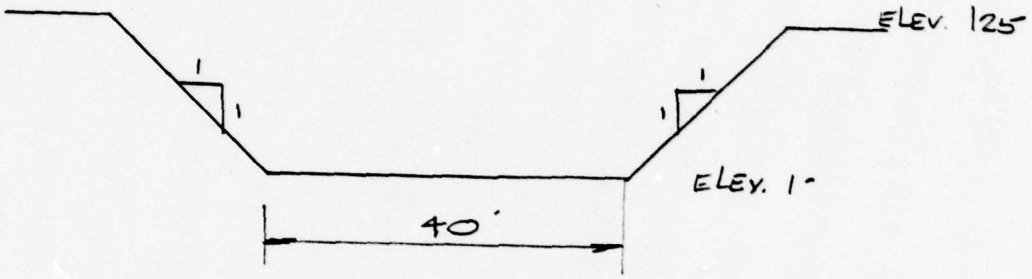
Drainage Area 6.9 Sq mi
Inflow @ 2 cfs/S.M = 14 cfs

Res ELE	Area Acre	Aver Area acre	Volume Ac-ft	Ave Res Ele	Q Aver Outlet Dis cfs $Q=CLH^{1.5}$ $=3\times7.7\,H^{1.5}$ $=23.1\times1.4^{1.5}$	t_1 hrs Time to drawdown $\frac{Vol\times2^c}{1.98\times Q}$	Cum time hrs	t_2 time to drawdown $\frac{2cSM}{\frac{14\times5}{Q}}$	Cum time hrs
113.8	25								
		23.2	23.2	113.3	583	0.73	0.73	.03	0.76
112.8	21.4								
		19.7	19.7	112.3	298	0.80	1.53	.04	1.60
111.8	17.9								
		16.1	16.1	111.3	221	0.88	2.41	.06	2.54
110.8	14.3								
		12.5	12.5	110.3	151	1.0	3.41	.09	3.63
109.8	10.7								
		8.9	8.9	109.3	91	1.19	4.60	.18	5.00
108.8	7.1								
		5.4	5.4	108.3	42	1.56	6.16	0.52	7.08
107.8	3.6								
		1.8	1.8	107.3	8	2.73	8.89	4.75	14.64
106.8	0								

A) TIME OF COMPLETE DRAWDOWN WITH NO INFLOW = 8.9 hrs

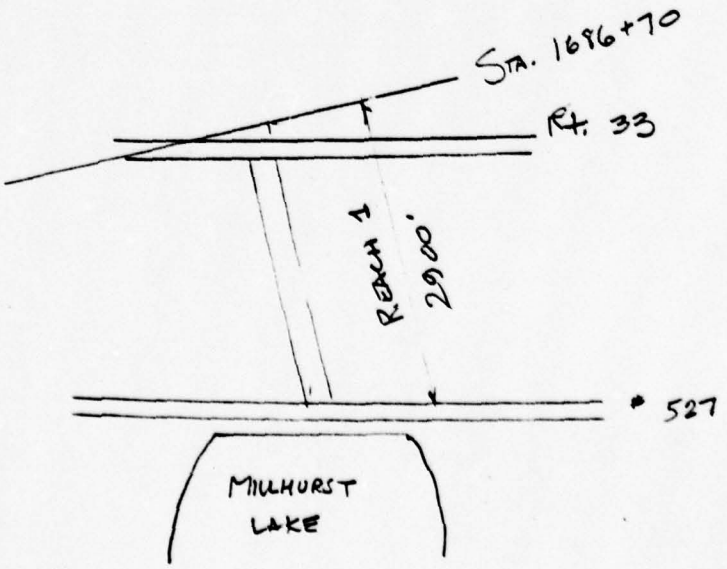
B) TIME OF COMPLETE DRAWDOWN WITH INFLOW @ 2 cfsm or 14 cfs = 14.6 hrs
(ASSUMED THAT THE SURFACE AREA OF RESERVOIR VARIES LINEARLY FROM 25 ACRES @ ELE. 113.8 to 0 ACRES @ Ele 106.8 which is considered the streambed of the dam)

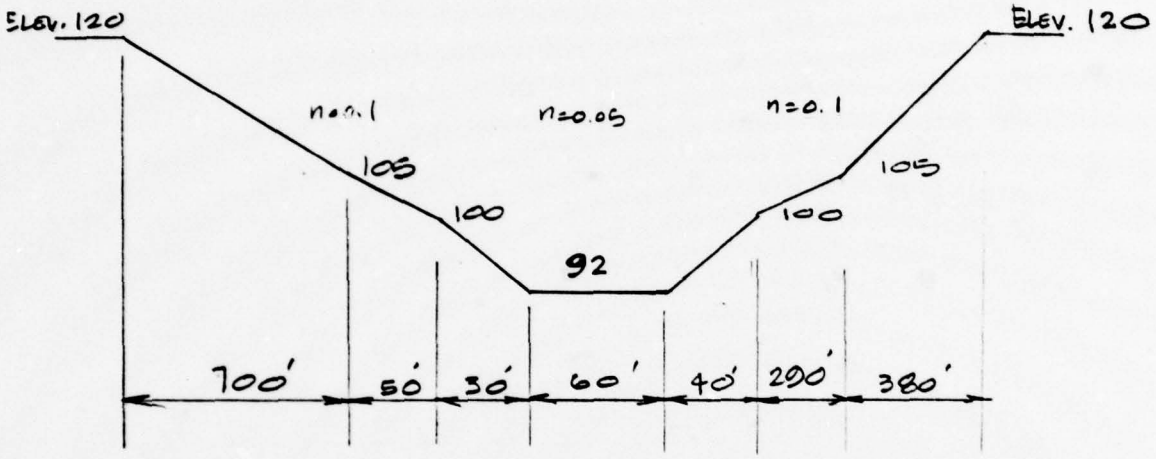
Assume breach begins to develop when reservoir Stage reaches elev. 125.0. Time of fully develop = 1.0 hr.



Fully Developed Breach

Assume bridge across the stream fails instantly upon impact of the flood wave. The resulting energy loss is negligible

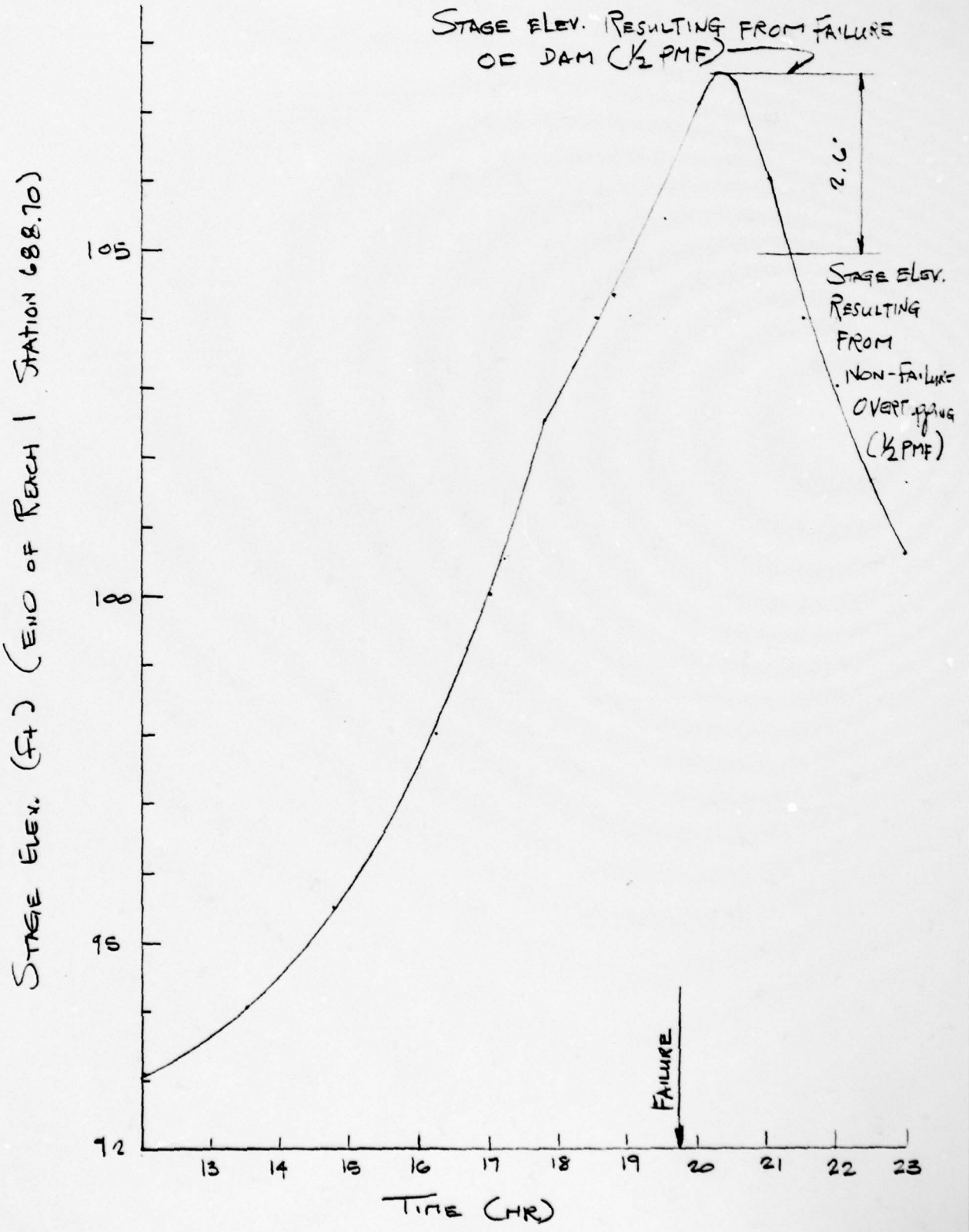




X-SECTION

END OF REACH 1 (STA. 1686+70)

S = 0.00103


STAGE ELEV. RESULTING FROM FAILURE OF DAM (½ PMF)
2.6'
STAGE ELEV. RESULTING FROM NON-FAILURE OVERTOPPING (½ PMF)
STAGE ELEV. (FT) (END OF REACH 1 STATION 688.70)
105
100
95
92
FAILURE
13
14
15
16
17
18
19
20
21
22
23
TIME (HR)

HEC1-DB

COMPUTER PRINT-OUT

```
A1                    N J DAM SAFETY INSPECTIONS PROGRAM---GROUP X
A2                    N J 00296 LAKE MILLHURST, MONMOUTH COUNTY, NJ
A3                    MUILT RATIO PMF ROUTING, F. R. HARRIS INC, WOODBRIDGE, NJ
B     150       0      15                                          0       0       3
B1      5
J       1       5       1
J1    0.5     0.4     0.3     0.2     0.1
K       0    LAKE                       0       0       1
K1                 INFLOW HYDROGRAPH THROUGH LAKE MILLHURST
M       1       2     6.9             6.9     0.8                             1
P       0      26     100     109     117
T                                                    1.0    0.12
W2            3.12
X      -1   -0.05       2
K       1     DAM                       0       0       1
K1                 ROUTING DISCJARGE THROUGH LAKE MILLHURST
Y                                  1       1
Y1      1                                          -113.8      -1
Y4 113.8   114.8   115.8   116.8   117.8   118.8   119.5     120   120.4   121.6
Y4 122.7     123     124   125.1
Y5      0      77     227     428     675     959    1180    1348    1350    1914
Y5   2934    3465    5278    7264
$A      0    24.8      67   229.6
$E  106.8   113.8     120     130
$$  113.8
$D  120.4
K      99
A
A
A
A
A
$
```

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
 LAST MODIFICATION  26 FEB 79
**********

RUN  DATE= 79/08/02.
     TIME= 23.57.02.
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N J DAM SAFETY INSPECTIONS PROGRAM---GROUP X
N J 00296 LAKE MILLHURST, MONMOUTH COUNTY, NJ
MUILT RATIO PMF ROUTING, F. R. HARRIS INC, WOODBRIDGE, NJ

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	0	15	0	0	0	0	0	3	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1
RTIOS= .50 .40 .30 .20 .10

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH THROUGH LAKE MILLHURST

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LAKE	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	6.90	0.00	6.90	.80	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	26.00	100.00	109.00	117.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.12	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= 3.12

RECESSION DATA
STRTQ= -1.00 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 64 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= 3.12 VOL= 1.00

24.	70.	131.	205.	300.	421.	559.	704.	831.	921.
984.	1019.	1027.	1019.	982.	931.	875.	812.	735.	648.
557.	478.	421.	370.	325.	286.	257.	229.	202.	178.
155.	138.	122.	107.	95.	83.	73.	65.	56.	50.
44.	39.	35.	30.	27.	24.	21.	19.	16.	14.
13.	11.	10.	9.	8.	7.	6.	6.	5.	4.
3.	2.	2.	1.						

PIT INFLOW HYDROGRAPH

(OD FLOW

MO. DA	HR. MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	19.00	76	.04	.01	.03	15516.
1.01	19.15	77	.04	.01	.03	15208.
1.01	19.30	78	.04	.01	.03	14729.
1.01	19.45	79	.04	.01	.03	14116.
1.01	20.00	80	.04	.01	.03	13366.
1.01	20.15	81	.04	.01	.03	12476.
1.01	20.30	82	.04	.01	.03	11479.
1.01	20.45	83	.04	.01	.03	10439.
1.01	21.00	84	.04	.01	.03	9442.
1.01	21.15	85	.04	.01	.03	8535.
1.01	21.30	86	.04	.01	.03	7672.
1.01	21.45	87	.04	.01	.03	6862.
1.01	22.00	88	.04	.01	.03	6120.
1.01	22.15	89	.04	.01	.03	5457.
1.01	22.30	90	.04	.01	.03	4841.
1.01	22.45	91	.04	.01	.03	4283.
1.01	23.00	92	.04	.01	.03	3787.
1.01	23.15	93	.04	.01	.03	3350.
1.01	23.30	94	.04	.01	.03	2985.
1.01	23.45	95	.04	.01	.03	2660.
1.02	0.00	96	.04	.01	.03	2371.
1.02	.15	97	0.00	0.00	0.00	2120.
1.02	.30	98	0.00	0.00	0.00	1894.
1.02	.45	99	0.00	0.00	0.00	1693.
1.02	1.00	100	0.00	0.00	0.00	1513.
1.02	1.15	101	0.00	0.00	0.00	1352.
1.02	1.30	102	0.00	0.00	0.00	1212.
1.02	1.45	103	0.00	0.00	0.00	1087.
1.02	2.00	104	0.00	0.00	0.00	973.
1.02	2.15	105	0.00	0.00	0.00	870.
1.02	2.30	106	0.00	0.00	0.00	778.
1.02	2.45	107	0.00	0.00	0.00	726.
1.02	3.00	108	0.00	0.00	0.00	677.
1.02	3.15	109	0.00	0.00	0.00	632.
1.02	3.30	110	0.00	0.00	0.00	590.
1.02	3.45	111	0.00	0.00	0.00	550.
1.02	4.00	112	0.00	0.00	0.00	513.
1.02	4.15	113	0.00	0.00	0.00	479.
1.02	4.30	114	0.00	0.00	0.00	447.
1.02	4.45	115	0.00	0.00	0.00	417.
1.02	5.00	116	0.00	0.00	0.00	389.
1.02	5.15	117	0.00	0.00	0.00	363.
1.02	5.30	118	0.00	0.00	0.00	339.
1.02	5.45	119	0.00	0.00	0.00	316.
1.02	6.00	120	0.00	0.00	0.00	295.
1.02	6.15	121	0.00	0.00	0.00	275.
1.02	6.30	122	0.00	0.00	0.00	257.
1.02	6.45	123	0.00	0.00	0.00	239.
1.02	7.00	124	0.00	0.00	0.00	223.
1.02	7.15	125	0.00	0.00	0.00	208.
1.02	7.30	126	0.00	0.00	0.00	195.
1.02	7.45	127	0.00	0.00	0.00	181.
1.02	8.00	128	0.00	0.00	0.00	169.
1.02	8.15	129	0.00	0.00	0.00	158.
1.02	8.30	130	0.00	0.00	0.00	147.
1.02	8.45	131	0.00	0.00	0.00	138.
1.02	9.00	132	0.00	0.00	0.00	128.
1.02	9.15	133	0.00	0.00	0.00	120.
1.02	9.30	134	0.00	0.00	0.00	112.
1.02	9.45	135	0.00	0.00	0.00	104.
1.02	10.00	136	0.00	0.00	0.00	97.
1.02	10.15	137	0.00	0.00	0.00	91.
1.02	10.30	138	0.00	0.00	0.00	85.
1.02	10.45	139	0.00	0.00	0.00	79.
1.02	11.00	140	0.00	0.00	0.00	74.
1.02	11.15	141	0.00	0.00	0.00	69.
1.02	11.30	142	0.00	0.00	0.00	64.
1.02	11.45	143	0.00	0.00	0.00	60.
1.02	12.00	144	0.00	0.00	0.00	56.
1.02	12.15	145	0.00	0.00	0.00	52.
1.02	12.30	146	0.00	0.00	0.00	49.
1.02	12.45	147	0.00	0.00	0.00	45.
1.02	13.00	148	0.00	0.00	0.00	42.
1.02	13.15	149	0.00	0.00	0.00	39.
1.02	13.30	150	0.00	0.00	0.00	37.
		SUM	24.34	21.30	3.03	384120.
			(618.)	(541.)	(77.)	(10877.07)

PMF INFLOW HYDROGRAPH

MO. DA	HR. MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERI COMP Q
1.01	.15	1	.03	0.00	.03	6.
1.01	.30	2	.03	0.00	.03	6.
1.01	.45	3	.03	0.00	.03	6.
1.01	1.00	4	.03	0.00	.03	5.
1.01	1.15	5	.03	0.00	.03	5.
1.01	1.30	6	.03	0.00	.03	5.
1.01	1.45	7	.03	0.00	.03	4.
1.01	2.00	8	.03	0.00	.03	4.
1.01	2.15	9	.03	0.00	.03	4.
1.01	2.30	10	.03	0.00	.03	3.
1.01	2.45	11	.03	0.00	.03	3.
1.01	3.00	12	.03	0.00	.03	3.
1.01	3.15	13	.03	0.00	.03	3.
1.01	3.30	14	.03	0.00	.03	3.
1.01	3.45	15	.03	0.00	.03	2.
1.01	4.00	16	.03	0.00	.03	2.
1.01	4.15	17	.03	0.00	.03	2.
1.01	4.30	18	.03	0.00	.03	2.
1.01	4.45	19	.03	0.00	.03	2.
1.01	5.00	20	.03	0.00	.03	2.
1.01	5.15	21	.03	0.00	.03	2.
1.01	5.30	22	.03	0.00	.03	2.
1.01	5.45	23	.03	0.00	.03	1.
1.01	6.00	24	.03	0.00	.03	1.
1.01	6.15	25	.08	0.00	.08	1.
1.01	6.30	26	.08	0.00	.08	1.
1.01	6.45	27	.08	0.00	.08	1.
1.01	7.00	28	.08	0.00	.08	1.
1.01	7.15	29	.08	.03	.04	2.
1.01	7.30	30	.08	.05	.03	4.
1.01	7.45	31	.08	.05	.03	10.
1.01	8.00	32	.08	.05	.03	19.
1.01	8.15	33	.08	.05	.03	32.
1.01	8.30	34	.08	.05	.03	50.
1.01	8.45	35	.08	.05	.03	75.
1.01	9.00	36	.08	.05	.03	107.
1.01	9.15	37	.08	.05	.03	145.
1.01	9.30	38	.08	.05	.03	188.
1.01	9.45	39	.08	.05	.03	234.
1.01	10.00	40	.08	.05	.03	283.
1.01	10.15	41	.08	.05	.03	332.
1.01	10.30	42	.08	.05	.03	381.
1.01	10.45	43	.08	.05	.03	428.
1.01	11.00	44	.08	.05	.03	474.
1.01	11.15	45	.08	.05	.03	516.
1.01	11.30	46	.08	.05	.03	556.
1.01	11.45	47	.08	.05	.03	593.
1.01	12.00	48	.08	.05	.03	625.
1.01	12.15	49	.52	.49	.03	663.
1.01	12.30	50	.52	.49	.03	718.
1.01	12.45	51	.52	.49	.03	797.
1.01	13.00	52	.52	.49	.03	906.
1.01	13.15	53	.62	.59	.03	1058.
1.01	13.30	54	.62	.59	.03	1265.
1.01	13.45	55	.62	.59	.03	1539.
1.01	14.00	56	.62	.59	.03	1883.
1.01	14.15	57	.78	.75	.03	2295.
1.01	14.30	58	.78	.75	.03	2766.
1.01	14.45	59	.78	.75	.03	3287.
1.01	15.00	60	.78	.75	.03	3850.
1.01	15.15	61	.79	.76	.03	4443.
1.01	15.30	62	1.58	1.55	.03	5079.
1.01	15.45	63	4.43	4.40	.03	5832.
1.01	16.00	64	1.11	1.08	.03	6689.
1.01	16.15	65	.73	.70	.03	7615.
1.01	16.30	66	.73	.70	.03	8589.
1.01	16.45	67	.73	.70	.03	9634.
1.01	17.00	68	.73	.70	.03	10751.
1.01	17.15	69	.57	.54	.03	11894.
1.01	17.30	70	.57	.54	.03	12994.
1.01	17.45	71	.57	.54	.03	13944.
1.01	18.00	72	.57	.54	.03	14675.
1.01	18.15	73	.04	.01	.03	15198.
1.01	18.30	74	.04	.01	.03	15505.
1.01	18.45	75	.04	.01	.03	15603.

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HYDROGRAPH ROUTING

ROUTING DISCJARGE THROUGH LAKE MILLHURST

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-114.	-1

STAGE	113.80	114.80	115.80	116.80	117.80	118.80	119.50	120.00	120.40	121.60
	122.70	123.00	124.00	125.10						
FLOW	0.00	77.00	227.00	428.00	675.00	959.00	1180.00	1348.00	1350.00	1914.00
	2934.00	3465.00	5278.00	7264.00						
SURFACE AREA=	0.	25.	67.	230.						
CAPACITY=	0.	58.	332.	1734.						
ELEVATION=	107.	114.	120.	130.						

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
113.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
120.4	0.0	0.0	0.

STATION DAM, PLAN 1, RATIO 1 (½ PMF)

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	2.	3.	5.	7.	11.	15.	20.	27.
34.	42.	51.	60.	70.	84.	103.	122.	140.	159.
178.	199.	224.	261.	307.	361.	426.	518.	621.	743.
882.	1036.	1208.	1349.	1526.	1815.	2268.	2785.	3542.	4326.
4999.	5578.	6069.	6475.	6797.	7036.	7191.	7261.	7249.	7159.
6991.	6746.	6432.	6062.	5656.	5230.	4793.	4358.	3936.	3532.
3159.	2864.	2674.	2476.	2277.	2082.	1902.	1805.	1704.	1600.
1495.	1389.	1349.	1348.	1260.	1173.	1093.	1016.	944.	880.
819.	761.	705.	655.	611.	569.	529.	491.	455.	422.
396.	371.	347.	324.	302.	281.	261.	243.	226.	214.
202.	190.	179.	168.	158.	149.	140.	131.	123.	115.
108.	101.	94.	88.	82.	77.	74.	71.	69.	66.

STORAGE

58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	58.	58.	58.	58.	58.	58.	58.	58.
58.	58.	59.	59.	59.	60.	61.	63.	65.	67.
69.	72.	75.	79.	83.	87.	91.	95.	99.	103.
107.	112.	118.	125.	133.	144.	157.	174.	193.	216.
242.	272.	305.	343.	387.	436.	488.	541.	593.	640.
683.	722.	756.	785.	808.	826.	838.	843.	842.	835.
823.	804.	782.	755.	727.	698.	670.	642.	616.	592.
570.	550.	530.	509.	489.	470.	452.	435.	417.	399.
382.	366.	349.	332.	315.	298.	282.	268.	254.	242.
230.	219.	209.	200.	191.	183.	176.	169.	163.	157.
151.	146.	141.	137.	132.	128.	125.	121.	118.	115.
112.	110.	107.	105.	103.	100.	98.	97.	95.	93.
92.	90.	89.	88.	86.	85.	84.	83.	82.	81.

STAGE

113.8	113.8	113.8	113.8	113.8	113.8	113.8	113.8	113.8	113.8
113.8	113.8	113.8	113.8	113.8	113.8	113.8	113.8	113.8	113.8
113.8	113.8	113.8	113.8	113.8	113.8	113.8	113.8	113.8	113.8
113.8	113.8	113.8	113.8	113.9	113.9	113.9	114.0	114.1	114.1
114.2	114.3	114.5	114.6	114.7	114.8	115.0	115.1	115.2	115.3
115.5	115.6	115.8	116.0	116.2	116.5	116.8	117.2	117.6	118.0
118.5	119.0	119.6	120.2	120.8	121.4	122.0	122.5	123.0	123.5
123.8	124.2	124.4	124.7	124.8	125.0	125.1	125.1	125.1	125.0
124.9	124.8	124.6	124.4	124.2	124.0	123.7	123.5	123.3	123.0
122.8	122.6	122.4	122.2	122.0	121.8	121.6	121.4	121.2	120.9
120.7	120.5	120.3	120.0	119.7	119.5	119.2	119.0	118.7	118.5
118.3	118.1	117.9	117.7	117.5	117.4	117.2	117.1	116.9	116.8
116.6	116.5	116.4	116.3	116.2	116.1	116.0	115.9	115.8	115.7
115.6	115.6	115.5	115.4	115.3	115.3	115.2	115.2	115.1	115.1
115.0	115.0	114.9	114.9	114.8	114.8	114.8	114.7	114.7	114.7

PEAK OUTFLOW IS 7261. AT TIME 19.50 HOURS

1 ********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .50	RATIO 2 .40	RATIO 3 .30	RATIO 4 .20	RATIO 5 .10
HYDROGRAPH AT	LAKE	6.90	1	7801.	6241.	4681.	3121.	1560.
		(17.87)		(220.91)(	176.73)(	132.55)(	88.36)(	44.18)(
ROUTED TO	DAM	6.90	1	7261.	5818.	4298.	2576.	1195.
		(17.87)		(205.60)(	164.73)(	121.71)(	72.96)(	33.83)(

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	113.80	113.80	120.40
STORAGE	58.	58.	360.
OUTFLOW	0.	0.	1350.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	125.10	4.70	843.	7261.	9.50	19.50	0.00
.40	124.30	3.90	738.	5818.	8.75	19.50	0.00
.30	123.46	3.06	639.	4298.	7.25	19.75	0.00
.20	122.31	1.91	519.	2576.	5.50	20.25	0.00
.10	119.54	0.00	302.	1195.	0.00	20.50	0.00

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A1                    N J DAM SAFETY INSPECTIONS PROGRAM---GROUP X
A2                    N J 00296 LAKE MILLHURST, MONMOUTH COUNTY, NJ
A3                    MUILT RATIO PMF ROUTING, F. R. HARRIS INC, WOODBRIDGE, NJ
B    150      0      15                                          0      0      5
B1     5
J      2      1       1
J1   0.5
K      0   LAKE                                  0      0      1
K1                 INFLOW HYDROGRAPH THROUGH LAKE MILLHURST
M      1      2    6.9           6.9    0.8                                  1
P      0     26    100    109    117
T                                                        1.0    0.12
W2          3.12
X     -1  -0.05      2
K      1    DAM                                  0      0      1
K1                 ROUTING DISCJARGE THROUGH LAKE MILLHURST
Y                                      1      1
Y1     1                                                -113.8     -1
Y4 113.8   114.8   115.8   116.8   117.8   118.8   119.5     120   120.4   121.6
Y4 122.7     123     124   125.1
Y5     0      77     227     428     675     959    1180    1348    1350    1914
Y5  2934    3465    5278    7264
$A     0    24.8      67   229.6
$E 106.8   113.8     120     130
$$ 113.8
$D 120.4
$B  40.0     1.0     107       1   113.8   125.0
$B  40.0     1.0     107     1.0   113.8     300
K      1 1688.70                                          1
K1   D/S LOC 1686+70 D/S OF RT. 33
Y                                      1      1
Y1     1                                                -1
Y6   0.1    0.05     0.1      92     120    2900 0.00103
Y7   450     120    1150     105    1200     100    1230      92    1290      92
Y7  1330     100    1620     105    2000     120
K      1 1632.50                                          1
K1   D/S LOC 1632+50 D/S OF WOODWARD RD. BRIDGE
Y                                      1      1
Y1     1                                                -1
Y6   0.1    0.05     0.1      88     100    5620 0.00071
Y7  1000     110    1200     100    1300      95    1350      88    1850      88
Y7  2060      95    2400     100    3800     100
K      1   1537.                                          1
K1   D/S LOC 1537+00  U/S IRON ORE RD. BRIDGE
Y                                      1      1
Y1     1                                                -1
Y6   0.1    0.05     0.1      73    87.5    9550 0.00157
Y7  1000      90    1240      85    1560      80    1580      73    1600      73
Y7  1630      80    2000      85    3000    87.5
K     99
A
A
A
A
A
A
A
$
```
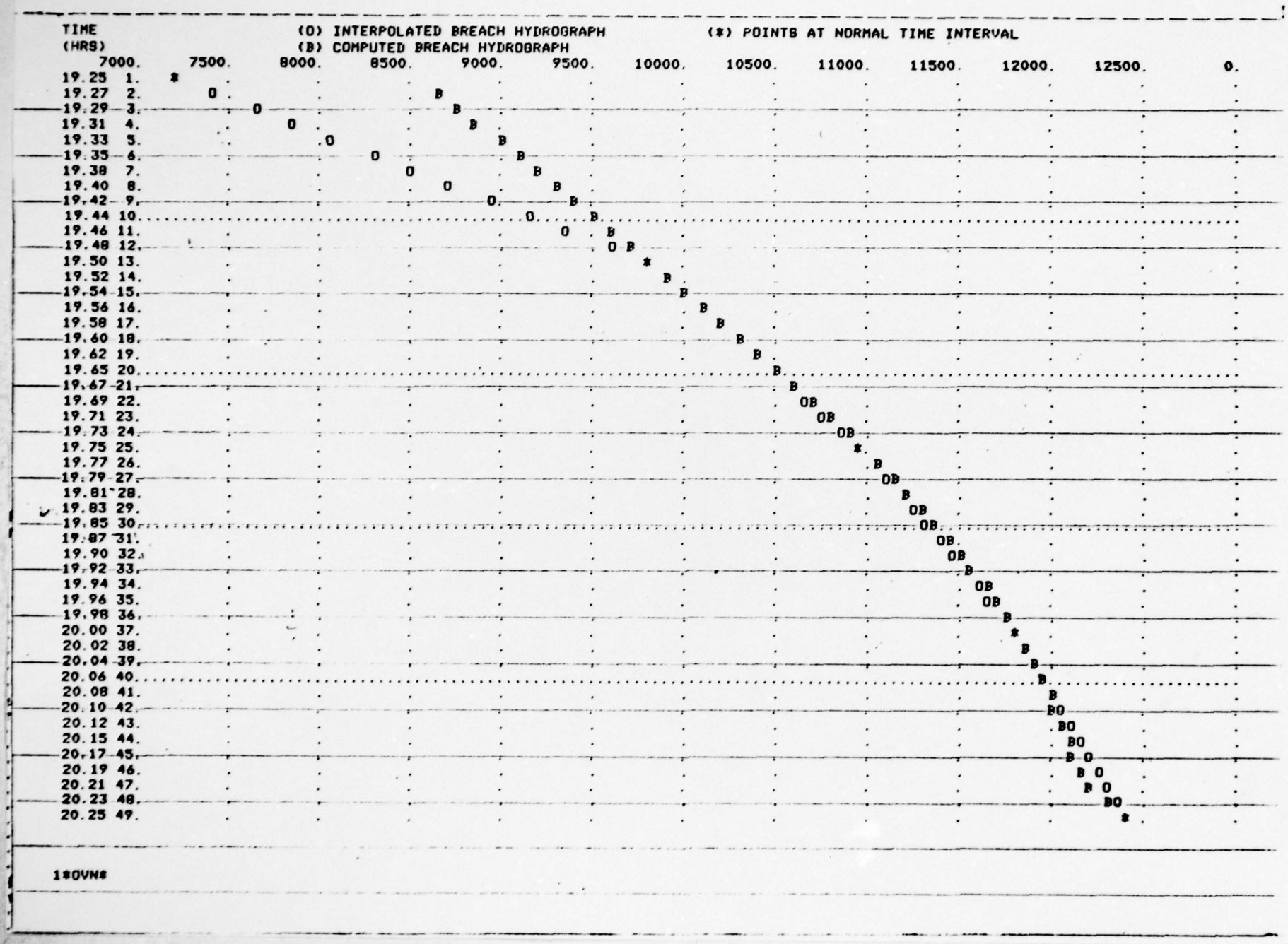


TIME
(HRS)
(O) INTERPOLATED BREACH HYDROGRAPH
(B) COMPUTED BREACH HYDROGRAPH
(*) POINTS AT NORMAL TIME INTERVAL
7000.
7500.
8000.
8500.
9000.
9500.
10000.
10500.
11000.
11500.
12000.
12500.
0.
19.25 1.
19.27 2.
19.29 3.
19.31 4.
19.33 5.
19.35 6.
19.38 7.
19.40 8.
19.42 9.
19.44 10.
19.46 11.
19.48 12.
19.50 13.
19.52 14.
19.54 15.
19.56 16.
19.58 17.
19.60 18.
19.62 19.
19.65 20.
19.67 21.
19.69 22.
19.71 23.
19.73 24.
19.75 25.
19.77 26.
19.79 27.
19.81 28.
19.83 29.
19.85 30.
19.87 31.
19.90 32.
19.92 33.
19.94 34.
19.96 35.
19.98 36.
20.00 37.
20.02 38.
20.04 39.
20.06 40.
20.08 41.
20.10 42.
20.12 43.
20.15 44.
20.17 45.
20.19 46.
20.21 47.
20.23 48.
20.25 49.
1*OVN*

N J DAM SAFETY INSPECTIONS PROGRAM---GROUP X
N J 00296 LAKE MILLHURST, MONMOUTH COUNTY, NJ
MUILT RATIO PMF ROUTING, F. R. HARRIS INC, WOODBRIDGE, NJ

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	0	15	0	0	0	0	0	5	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

SURFACE AREA=	0.	25.	67.	230.
CAPACITY=	0.	58.	332.	1734.
ELEVATION=	107.	114.	120.	130.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
113.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
120.4	0.0	0.0	0.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
40.	1.00	107.00	1.00	113.80	125.00

BEGIN DAM FAILURE AT 19.25 HOURS

PEAK OUTFLOW IS 12396. AT TIME 20.25 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
40.	1.00	107.00	1.00	113.80	300.00

PEAK OUTFLOW IS 7261. AT TIME 19.50 HOURS

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0500	.1000	92.0	120.0	2900.	.00103

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

450.00 120.00 1150.00 105.00 1200.00 100.00 1230.00 92.00 1290.00 92.00
1330.00 100.00 1620.00 105.00 2000.00 120.00

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0500	.1000	88.0	100.0	5620.	.00071

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

1000.00 110.00 1200.00 100.00 1300.00 95.00 1350.00 88.00 1850.00 88.00
2060.00 95.00 2400.00 100.00 3800.00 100.00

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0500	.1000	73.0	87.5	9550.	.00157

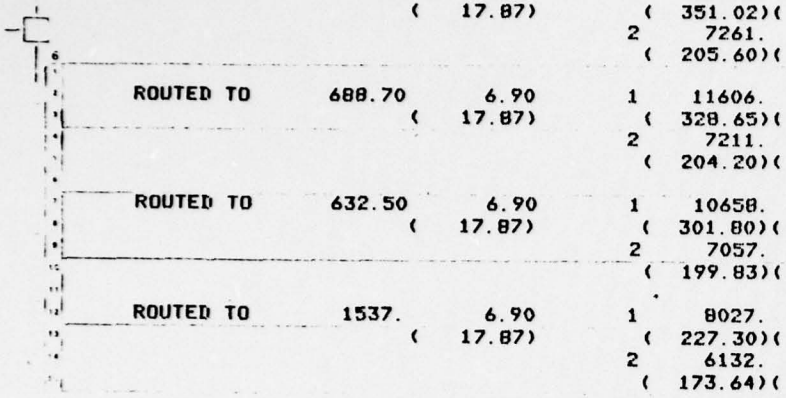
CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

1000.00 90.00 1240.00 85.00 1560.00 80.00 1580.00 73.00 1600.00 73.00
1630.00 80.00 2000.00 85.00 3000.00 87.50

1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO APPLIED TO FLOWS 1
				.50
HYDROGRAPH AT	LAKE	6.90	1	7801.
		(17.87)		(220.91)(
			2	7801.



				(220.91)(
ROUTED TO	DAM	6.90	1	12396.
		(17.87)		(351.02)(
			2	7261.
				(205.60)(
ROUTED TO	688.70	6.90	1	11606.
		(17.87)		(328.65)(
			2	7211.
				(204.20)(
ROUTED TO	632.50	6.90	1	10658.
		(17.87)		(301.80)(
			2	7057.
				(199.83)(
ROUTED TO	1537.	6.90	1	8027.
		(17.87)		(227.30)(
			2	6132.
				(173.64)(

1

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	113.80	113.80	120.40
STORAGE	58.	58.	360.
OUTFLOW	0.	0.	1350.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	125.06	4.66	838.	12396.	4.50	20.25	19.25

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	113.80	113.80	120.40
STORAGE	58.	58.	360.
OUTFLOW	0.	0.	1350.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	125.10	4.70	843.	7261.	9.50	19.50	0.00

PLAN 1 STATION 688.70

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	11606.	107.5	20.25

PLAN 2 STATION 688.70

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	7211.	104.9	19.75

AD-A073 995 NEW JERSEY STATE DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/2
NATIONAL DAM SAFETY PROGRAM. MILLHURST LAKE DAM, NJ-00296. RARI--ETC(U)
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2 OF 2
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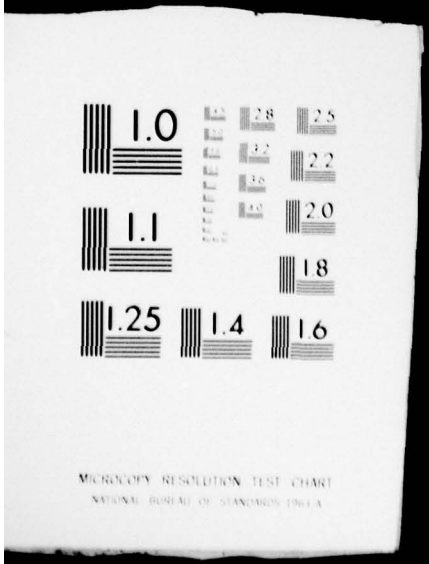
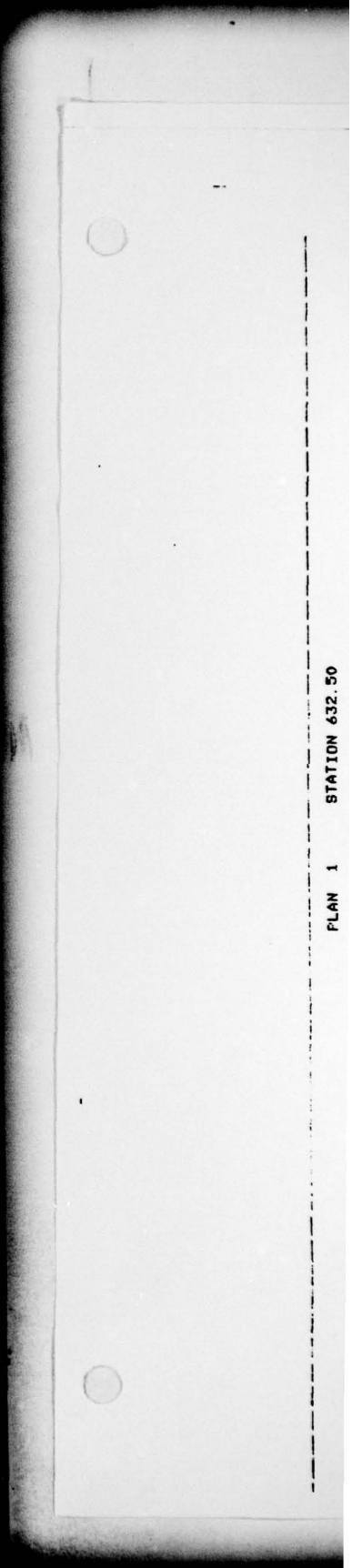

1.0
1.1
1.25
1.4
1.6
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.8
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A


PLAN 1
STATION 632.50

PLAN 1 STATION 632.50

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.50	10658.	94.8	20.75

PLAN 2 STATION 632.50

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.50	7057.	93.4	20.25

PLAN 1 STATION 1537.

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.50	8027.	86.5	21.50

PLAN 2 STATION 1537.

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.50	6132.	85.5	21.50